Vol. 11, No. 1
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Energy Research Abstracts

Abstracts 1-1946

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available (use PB86-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual price is $18.00 for domestic (North America) or $36.00 for foreign (outside North America); a single issue is $9.00 or $18.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB86-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $85.00 for domestic (North America) and $170.00 for foreign (outside North America) subscribers; a single issue is $8.00 and $16.00, respectively.

***Current Energy Patents (CEP)*–PB86-902800.** International patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB86-914900.** Impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB86-914600.** The exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB86-915300.** Information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB86-914500.** The utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $45.00 for domestic (North America) and $90.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB86-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB86-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB86-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)*–PB86-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB86-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB86-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB86-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB86-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB86-900500.** Heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB86-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB86-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB86-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB86-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB86-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB86-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB86-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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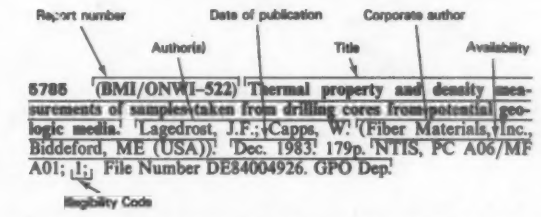
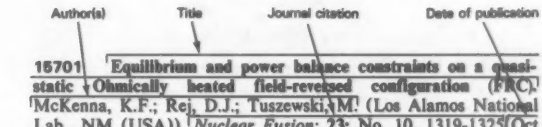
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Abstract: Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static, Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract: Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

● Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

● Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

● Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

● Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI–522

● Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI–522 9:5785 NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
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Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
London, England

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National Aeronautics and Space Administration
Scientific and Technical Information Division
Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 39 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semi-monthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

1 **(DOE/FE/60181—1845) Low-rank coal research. Quarterly technical progress report, October-December 1984.** (North Dakota Univ., Grand Forks (USA). Energy Research Center). Oct 1985. Contract FC21-83FE60181. 307p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86002156.

Progress in UNDERC-low rank coal research programs is described: Treatment of gasification plant waste water, hydrogen production, fuel slurries, liquefaction of low rank coal, SO_2/NO/ sub x/ air pollution control, coal preparation, boilers fouling, fluidized-bed combustion, combustion additives, structural chemical analysis, pyrolysis, devolatilization, etc. (LTN)

2 **(ORNL—6200) Fossil Energy Program quarterly progress report for the period ending June 30, 1985.** Bradley, R.A. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001369.

This report covers progress made during the period April 1 through June 30, 1985, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by DOE Office of Fossil Energy, DOE Office of Basic Energy Sciences, the Electric Power Research Institute, and the Tennessee Valley Authority. The Fossil Energy Program organization chart is shown in Appendix A. Summaries and progress reports are presented for the following: (1) materials research and development; (2) fossil energy enviromental programs; (3) coal conversion development; (4) process analysis and development; (5) generalized equilibrium models of liquids and gaseous fuels supply; (6) fluidized bed combustion joint program; and (7) coal chemistry.

0104 Processing

REFER ALSO TO CITATION(S) 35, 47, 53, 70, 78, 85, 279, 541, 1266

3 **(CONF-8310407—, pp 265-273) Modelling of gasification processes in situ.** Marzilger, B. 1983. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE86770012.

From Seminar on properties and reactions of coal for underground conversion processes and in situ measuring processes; Hannover, F.R. Germany (12 Oct 1983).

One generally distinguishes between two main types of processes in underground gasification, filtration and channel processes. Due to the difference between the processes with regard to the effect of road mechanics on the seam structure during the gasification process, the view up to now has been that generalized models are not available for practical calculations. In previous attempts at developing a simulation, one took these problems into account, insofar as simulation models were developed either for channel gasification, or its modifications, or for the filtration process. Due to the great complexity of the associated kinetics, transport and fluid dynamics problems, the simulators were previously almost exclusively developed in one dimensional or two dimensional versions, where the calculations were quasi-stationary or non-stationary, as required. As these were basic investigations, the questions of speed of the front, degree of conversion, qualities of the product gas and reaction kinetics investigations were given priority over questions of the degree of total decarburization of the seam which can be achieved, which can only be realistically calculated in a 3 D version. A two dimensional simulator of hydrating underground gasification was developed at Bergbau-Forschung GmbH in the period 1978-80. With this, the course of the process is calculated by the penetration process with a plane, two dimensional model using a vertical section through the seam.

4 **(CRIEPI-E—284003) Laboratory combustion study on utilization of coal-derived liquid fuels in utility boilers.** Sato, M.; Sema, T.; Ninomiya, T.; Makino, H.; Endo, K. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1984. 54p. Central Research Institute of Electric Power Industry, Tokyo, Japan.

Evaluation of a coal-derived liquid fuel from the Exxon Donor Solvent (EDS) process, for utility boilers was conducted. Three types of EDS are examined: Illinois EDS fuel, made from bituminous coal; Wyodak EDS fuel, made from subbituminous coal; and Texas EDS fuel, made from lignite coal. Investigations are made of the combustion and emission characteristics of the fuels, and it is concluded that if it is possible to pass the environment standard of NO/sub x/ emission, it would be possible to use EDS fuels in conventional oil-fired boilers.

5 **(DOE/ET/10069—T117) EDS coal liquefaction process development. Phase V. EDS Consolidation Program: Economic Studies.** (Exxon Research and Engineering Co., Annandale, NJ (USA)). Sep 1985. Contract FC05-77ET10069. 170p. NTIS (US Sales Only), PC A08/MF A01; 1; GPO Dep. File Number DE86000538.

This report documents the results of the EDS Consolidation Program: Economics Studies. The study results represent a consolidation of learnings accrued during previous phases of the EDS Project including results obtained from ECLP operations, from past EDS Study Design preparations, and learnings in the EDS Project since the completion of the EDS Wyoming Coal Bottoms Recycle Study Design (Base Case and Addendum). This study represents the first economic evaluation where five EDS sponsor coals were screened on a consistent basis and the economics presented on an absolute basis. Screening the five coals on a consistent basis has allowed, for the first time, comparisons of EDS case economics on an inter-coal and absolute basis. Overall results from this study provide the relative economic ranking of coals as feedstocks to an EDS plant as a function of a variety of factors. These factors include coal properties (moisture, oxygen, sulfur and ash contents), coal yield responses, coal cost, and plant investment. 25 refs., 29 figs., 12 tabs.

6 **(DOE/MC/16518—T1-Vol.1) Prediction and measurement of entrained flow coal gasification processes. Volume I. Final report, 8 September 1983-28 February 1985.** Hedman, P.O.; Smoot, L.D.; Smith, P.J.; Blackham, A.U. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 28 Feb 1985. Contract AC21-81MC16518. 238p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85017055.

This volume reports experimental and theoretical results of a study of entrained coal gasification with steam and oxygen. Interim results were reported in a previous report. The gasifier facility and testing methods were revised and substantially improved. The gasifier was also modified for high pressure operation. Fifty-four gasification tests were completed since the interim report to complete optimization tests and mapping tests for four coal types at atmospheric pressure. Effects of coal type, reactant feedrates and proportions, and coal size on carbon conversion and gas composition were identified and partially correlated. Seventeen tests were conducted at elevated pressures to 140 psig with the Utah bituminous coal for premixed and diffusion flames. Effects of pressure, reactant feedrates and proportions and flame type on carbon conversion and gas composition are reported. The LDV system was used on the

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cold-flow facility to make additional nonreactive jet mixing measurements (local mean and turbulent velocity) to validate the two-dimensional code. The previously completed two-dimensional entrained coal gasification code, PCGC-2, was evaluated through rigorous comparison with cold-flow, pulverized coal combustion, and entrained coal gasification data from this laboratory and other laboratories. A complete set of the data used has been compiled into a Data Book which is included as Volume 3 of this final report. A revised user's manual for the two-dimensional code has been prepared and is also included as Volume 2 of this final report. Ease of PCGC-2 operation and numerical efficiency for gasification was improved and the first comprehensive application of the code to entrained gasification was conducted, with twenty-two converged gasification solutions being obtained. 153 references, 101 figures, 17 tabs.

7 (DOE/MC/16518—T1-Vol.2) **Prediction and measurement of entrained flow coal gasification processes. Volume II. User's Manual for a computer program for 2-dimensional coal gasification or combustion (PCGC-2). Final report, 8 September 1983-28 February 1985.** Smith, P.J.; Fletcher, T.H.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 28 Feb 1985. Contract AC21-81MC16518. 710p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85017056.

A two-dimensional, steady-state model for describing pulverized coal combustion and gasification is presented. The model is applicable to cylindrical axi-symmetric systems. Turbulence is accounted for in both the fluid mechanics equations and the combustion scheme. Radiation from gases, walls, and particles is taken into account using a flux method. The particle phase is modeled in a Lagrangian framework, so that individual paths of particles are followed. A two-step coal devolatilization scheme is used along with a heterogeneous reaction scheme that allows for both diffusion and chemical reaction. Gas-phase reactions are modeled assuming infinite rate kinetics, meaning that the reaction rates are limited by the turbulent rate of mixing. The gas phase is described by elliptic partial differential equations that are solved by an iterative line-by-line technique. Under-relaxation is used to achieve numerical stability. The generalized nature of the model allows for calculation of both coal combustion and coal gasification characteristics. User information is presented, along with a sample computation and a listing of the program. This version of the User's Manual includes revisions made specific to gasification applications. The code described in this User's Manual includes updated revisions on (1) incorporation of swirling flow capabilities, (2) improvement in the coal devolatilization model parameters to better cover a wide range of fuels, (3) improvements in the coal oxidation model including the most recent parameters for US coals, and (4) inclusion of an energy equation for non-adiabatic operation. 142 refs., 21 figs., 23 tabs.

8 (DOE/MC/21108—3) **Management of coal waste by energy recovery: mild gasification/flash pyrolysis of coal preparation wastes. Quarterly report, April-June, 1985.** McCown, F.E. (UCC Research Corp., Bristol, VA (USA)). Jul 1985. Contract AC21-84MC21108. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001295.

The topical report, which summarized the literature survey on waste and its management, was issued and approved by the Department of Energy; this completed Task 1. In consideration of favorable information received from several sources, it was previously recommended that the original high pressure gasification system be changed to a larger low pressure unit. The proposed new system required a contract modification, which, after several reports and meetings, was achieved. A new management plan reflecting the increased costs and 20-month time frame for the contract change was prepared and issued. Industrial Machine Company was approved as the subcontractor for the erection and construction of the mild gasification development unit. Several modifications were made in the system drawings. Structural steel was fabricated and erected. The foundation and concrete pad were completed as were gas and water lines to the unit. Most of the feedstocks to be tested in the mild gasification system were selected.

9 (DOE/METC—85/3, pp 28-40) **Control of alkali vapors by a granular-bed sorber.** Lee, S.H.D.; Henry, R.F.; Myles, K.M. 1985. NTIS, PC A20/MF A01. File Number DE85001954. (CONF-8405124—).

From 4. annual contractors' meeting on contaminant control in hot coal-derived gas streams; Morgantown, WV, USA (15 May 1984).

This work supports the program to develop granular sorbents for the control of alkali vapors from pressurized fluidized-bed combustion (PFBC). A laboratory-scale pressurized test unit was used to characterize two potential sorbents identified earlier, activated bauxite and Emathlite. Experimental tests have been conducted to measure the rate of alkali (Na and K) evolution from the sorbent material itself in a gas stream with temperature (850°C), pressure (10 atm absolute), and composition closely simulating actual PFBC flue gas. The rate was then used to evaluate the significance of the alkali evolution for its possible effect on the turbine by comparing with the currently accepted alkali tolerance of an industrial gas turbine. A laboratory-scale demonstration of use of a granular-bed sorber for the control of alkali vapors from PFBC has been initiated. Details of a high temperature/high pressure sorber system designed for this demonstration are discussed. (12 refs.)

10 (DOE/METC—85/3, pp 358-382) **Development of the mixed metal oxide process for high temperature fuel gas desulfurization and a ceramic-supported molten alkali carbonate sorbent for high temperature HCl removal.** Anderson, G.L.; Berry, F.O.; Gross, M.N. 1985. NTIS, PC A20/MF A01. File Number DE85001954. (CONF-8405124—).

From 4. annual contractors' meeting on contaminant control in hot coal-derived gas streams; Morgantown, WV, USA (15 May 1984).

During the past year, several alternative metal oxide- containing sorbents have undergone laboratory-scale screening tests to determine their suitability for use in the IGT mixed metal oxide process for high temperature fuel gas desulfurization. Based on these tests, two mixtures of metal oxide-containing sorbents have been selected for upcoming bench-scale tests. These are 1) a combination of cobalt titanate- and zinc oxide- containing sorbents and 2) a combination of cobalt titanate-, zinc oxide- and cobalt oxide-containing sorbents. The first mixture is expected to be able to reduce the sulfur content of a typical coal-derived fuel gas to less than 30 ppm at 1200°F while the second mixture is expected to be able to reduce the sulfur content to less than 1 ppm. However, the most important attribute of either mixture is that when regenerated with air and recycled tail gas from the regeneration, the fuel gas sulfur is expected to be recovered as elemental sulfur rather than SO_2. Laboratory-scale studies on a ceramic-supported molten alkali carbonate sorbent for the removal of HCl from high temperature fuel gases have also been completed. (2 refs.)

11 (DOE/PC/60787—8) **Composite-bed reactor for upgrading coal-derived liquids. Quarterly report No. 8, July 1-September 30, 1985.** Crynes, B.L.; Seapan, M. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 18 Oct 1985. Contract FG22-83PC60787. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001713.

Four batch reactor experiments were conducted and one experiment was completed in the Catalyst Life Test Unit (CLTU). All experiments used a NiMo catalyst, TK-771 (Topsphie). The batch experiments were conducted to prepare a catalyst with varying levels of coke content and resultant pore size distribution. This was to be a controlled coking experiment to prepare catalysts with specific properties to be used for further testing in zoned bed reactors. Under the operating conditions and feedstocks utilized, the changes in the catalyst physical properties fell within too narrow a range. The basic approach is valid, but the conditions utilized did not yield the desired results. The decision was made to conduct zone bed studies using fresh catalysts instead of these aged, coked catalysts. The experiment in the CLTU trickle bed reactor was conducted at 370°C, 12.4 MPa, space time of 2.3 h and for a duration of 120 h. The feedstock was a mixture of quinoline and n-hexadecane (1 weight percent nitrogen content). Over the first 84 hours of the experimental run, from 90 to 96% removal of nitrogen was achieved. From 84 to 120 hours a precipitous rate of catalyst deac-

tivation occurred. This experiment is part of a base data set for the zoned bed study. 5 figs., 2 tabs.

12 **(DOE/PC/70801—2) Thermodynamic properties for supercritical coal conversion. Quarterly progress report, July 1-September 30, 1985.** Eckert, C.A. (Illinois Univ., Urbana (USA). Dept. of Chemical Engineering). Oct 1985. Contract FG22-84PC70801. 4p. NTIS, PC A02. File Number DE86000553.

We have measured the concentration effect of the entrainer in doped-solvent systems. The addition of a small amount of a polar entrainer can greatly enhance the supercritical solubility. The selectivity, sometimes poor in a pure solvent, greatly increases with the addition of the dopant. A system to dope small amounts of the entrainer in the fluid and an analytical technique to analyze the results have been developed. Measurements have been made on the effect of concentration of either methanol or acetone in carbon dioxide on the solubility of acridine in the mixed supercritical solvent. For higher temperature studies, work has continued in measuring the solubility of coal-type compounds in supercritical butane. We have measured the solubility of thioxanthone, xanthone, and phenazine at 162 and 182°C. The solubilities are relatively high. We are currently measuring the vapor pressure of these compounds so that the solubility behavior can be fully represented. We have used a decorated lattice-gas to model binary supercritical solutions. By fitting lattice parameters that characterize molecular structure, we have related the lattice dynamics to the actual binary fluid dynamics. Work has continued in analyzing the kinetic solvent effect of supercritical propane on the dimerization of cyclopentadiene. It appears that the reaction rate constant is slightly decreased through the supercritical region. The solvent effect is small and appears to be quite dependent upon the operating conditions and the nature of the reaction.

13 **(DOE/PC/70812—4) Improved catalysts for coal liquefaction. Quarterly report No. 4, June 1-August 31, 1985.** Haynes, H.W. Jr.; Baker, J.R.; McCormick, R.L. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 30 Sep 1985. Contract FG22-84PC70812. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000986.

Two bench scale hydrotreating runs were completed during the last quarter. With occasional exceptions the carbon material balances fell within the acceptable range of 100 +- 5%. Problems were experienced in adjusting the reactor temperature profile, and a shield has been designed with provisions for injecting cooler air in order to obtain near isothermal operation. In both runs the unit plugged after some 200+ hours on stream. Despite the wide range of operating conditions we were able to add at most only about 1% hydrogen to the feed. We believe that a thermodynamic limitation may be responsible for our inability to add substantial amounts of hydrogen to the feedstock, and efforts are underway to locate a more hydrogen deficient feed. We are sulfiding our catalysts prior to analysis by temperature programmed desorption (TPD). Sulfiding reduces the number of acid sites, but trends reported earlier for the oxidic catalysts appear to be unaltered. A study of the effects of various promotors on catalyst acidity was initiated during the last quarter and results are reported for sodium on Shell 324M. 10 refs., 10 figs., 4 tabs.

14 **(DOE/PC/70814—1) Direct coal liquefaction using iron-titanium hydride as a hydrogen distribution and catalytic material. Yearly report No. 1, September 1, 1984-August 31, 1985.** Smith, J.E. Jr. (Alabama Univ., Huntsville (USA). Dept. of Chemical Engineering). 29 Sep 1985. Contract FG22-84PC70814. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002328.

During this year the experimental apparatus was completed after substantial delays by the manufacturer and eight direct coal liquefaction experiments were accomplished. These experiments have produced conversion and selectivity data on samples of Utah coal slurried in tetralin and catalyzed using iron-titanium hydride. Hydrogen loading of the alloy, catalyst particle size, catalyst concentration, coal particle size, operating temperatures for alloy addition and liquefaction without the catalysts present, have all been studied during these experiments. Conversions as high as 61% DAF in 30 min have been recorded at 500°F and 500 psia. Product selectivities favor the oil fraction during the initial phase of the reaction, but as the reaction proceeds the heavier fractions are observed to increase at the expense of the oil fraction. We are currently working on a kinetic model in an effort to predict these results. Additionally, proton NMR, fractional distillation, and chromatographic analyses are currently being performed on the recovered product. We have completed the study of Utah coal and are moving on to samples of Kentucky and Alabama coals after a minor modification of the experimental apparatus is completed. Equipment manufacture, delivery, and installation delays, totaling over 6 months, greatly reduced the time available for research, making a 6 month no cost extension necessary. The extended time will permit completion of the proposed research tasks. 10 figs., 8 tabs.

15 **(DOE/PETC/TR—86/1) Effect of Ni/Mo and Ni/W ratio on the activity of coal-liquid upgrading catalysts.** Tischer, R.E.; Narain, N.K.; Stiegel, G.J.; Cillo, D.L. (USDOE Pittsburgh Energy Technology Center, PA). Nov 1985. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001861.

Current emphasis in many direct coal liquefaction processes involves a two-stage approach consisting of a thermal and catalytic stage. In this scheme, the catalytic second stage is used to upgrade the thermally generated coal liquids and to produce a good recycle solvent that promotes the thermal-dissolution processes occurring in the first stage. The catalysts currently used in the second stage are not optimized for use with coal liquids. Therefore, an investigation was conducted to assess the relative activity of catalysts with varying Ni/Mo or Ni/W atomic ratios in these systems. Initial activities of these catalysts were obtained using a 50/50 mixture of coal-liquid residuum and process solvent. The results indicate that the Ni-Mo catalysts are superior to the Ni-W catalysts for upgrading coal liquids. The results also indicate that changing the Ni/Mo and Ni/W ratios has only a moderate effect on the hydrogenation and denitrogenation activity of the catalysts but a somewhat larger effect on desulfurization activity and the conversion of coal liquids to cyclohexane soluble products. Under the experimental conditions tested, the ability of the catalyst to convert coal-liquid residuum to -340°C distillate is small and is not affected by the Ni/Mo or Ni/W atomic ratio. The optimum activity of the Ni-Mo catalysts for hydrogenation, denitrogenation, desulfurization, and conversion of coal-liquid residuum to cyclohexane soluble products occurs at a Ni/(Ni + Mo) atomic ratio of about 0.4, while that of the Ni-W catalysts occurs at a Ni/(Ni + W) atomic ratio of about 0.5. 24 refs., 10 figs., 8 tabs.

16 **(ORNL/FMP—85/3) AR and TD fossil energy materials program. Quarterly progress report for the period ending June 30, 1985.** (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 369p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE86001368.

The objective of the AR & TD Fossil Energy Materials Program is to conduct research and development on materials for fossil energy applications with a focus on the longer-term and generic needs of the various fossil fuel technologies. The program includes research aimed toward a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial enhancement of plant operations and reliability. The ORNL Fossil Energy Materials Program Office compiles and issues this combined quarterly progress report from camera-ready copies submitted by each of the participating subcontractor organizations. This report of activities on the program is organized in accordance with a work breakdown structure defined in the AR & TD Fossil Energy Materials Program Plan for FYs 1985 to 1989 in which projects are organized according to fossil energy technologies. It is the intent of the AR & TD Fossil Energy Materials Program to sponsor materials research which is generic to a number of fossil energy technologies. We hope this series of quarterly progress reports will aid in the dissemination of information developed on the program.

17 **(SAND—85-7238) Impact of rank-related coal properties on the response of coals to continuous direct liquefaction processes.** Tomlinson, G.C.; Gray, D.; Neuworth, M.B.; Talib, A. (Mitre Corp., McLean, VA (USA)). Oct 1985. Contract AC04-76DP00789. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001937.

The results of processing coal of various rank in continuous flow coal liquefaction processes are reviewed in an effort to correlate liquefaction process requirements to rank related coal properties. The results show markedly different trends than have been shown in correlations based on batch processing. Younger coals are more difficult to dissolve, but produce excellent oil yields at relatively low hydrogen consumption when processed in appropriately catalyzed continuous flow processes employing a recycle of undissolved bottom material to the dissolver. 32 refs., 17 figs., 29 tabs.

18 **(SFR—101) Coal gasification technology.** (Fluor Corp., Irvine, CA (USA)). 1979. 162p. Fluor Corporation.

To provide basic information on why coal gasification is needed and what processes are available or under development, Fluor Corp., has compiled an overview of coal-gasification technology that includes descriptions and diagrams of processes that are: 1) commercial (Koppers-Totzek, Lurgi pressure, Wellman-Galusha, and Winkler); 2) ready for development (British Gas Corp./Lurgi slagging, Shell-Koppers, and Texaco); and 3) being developed (Bituminous Coal Research, Bi-Gas, Babcock and Wilcox, Combustion Engineering, CO_2 Acceptor, COGAS, Foster Wheeler, GEGAS, Hydrane, HYGAS, Rockgas, Synthane, U-GAS, Union Carbide/Battelle, and Westinghouse). In addition, Fluor describes its experience and capabilities in several areas related to coal gasification.

19 **(UCRL—50032-84) LLNL Underground Coal Gasification Project annual report - fiscal year 1984.** Stephens, D.R.; O'Neal, E.M. (eds.). (Lawrence Livermore National Lab., CA (USA)). 15 Jun 1985. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86002362.

The Laboratory has been conducting an interdisciplinary underground coal gasification program since 1974 under the sponsorship of DOE and its predecessors. We completed three UCG tests at the Hoe Creek site near Gillette, Wyoming, during the period 1975 to 1979. Five small field experiments, the large-block tests, were completed from 1981 to 1982 at the exposed coal face in the WIDCO coal mine near Centralia, Washington. A larger test at the same location, the partial-seam CRIP test, was completed during fiscal year 1984. In conjunction with the DOE and an industrial group lead by the Gas Research Institute, we have prepared a preliminary design for a large-scale test at the WIDCO site. The planned test features dual injection and production wells, module interaction, and consumption of 20,000 tons of coal during a hundred-day steam-oxygen gasification. During fiscal year 1984, we documented the large-block excavations. The cavities were elongated, the cavity cross sections were elliptical, and the cavities contained ash and slag at the bottom, char and dried coal above that, and a void at the top. The results from the large-block tests provided enough data to allow us to construct a composite model, CAVSM. Preliminary results from the model agree well with the product-gas chemistry and cavity shape observed in the large-block tests. Other models and techniques developed during the year include a transient, moving-front code, a two-dimensional, reactive-flow code using the method of lines, and a wall-recession-rate model. In addition, we measured the rate of methane decomposition in the hot char bed and developed an engineering rate expression to estimate the magnitude of the methane-decomposition reaction. 16 refs., 30 figs., 1 tab.

20 **Methanation studies: characterization of some iron catalysts by x-ray diffraction and Curie point determinations.** Fournier, J.; Carreiro, L.; Soled, Y.T.Q.S.; Kershaw, R.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI). *Journal of Solid State Chemistry;* **58**: No. 2, 211-220(1 Jul 1985).

Methanation studies have been carried out at 290°C in a microreactor with a H_2/CO ratio of 9/1. The catalysts studied were iron(III) oxide, iron(II) diiron(III) tetraoxide, and metallic iron. These were all prepared reproducibly from iron(III) nitrate. The catalysts were characterized by X-ray diffraction and magnetic analysis both at maximum activity and after deactivation. All catalysts at maximum activity contained Fe_5C_2. Deactivation of the catalysts was found to be due to excess graphitic carbon. Sustained catalytic activity was found to require the presence of iron(II) diiron(III) tetraoxide, probably to serve as a source for continual renewal of the active catalyst surface. 11 references, 9 figures, 1 table.

21 **Electrochemical removal of HrS from hot coal gas: Electrode kinetics.** Winnick, J. (Georgia Inst. of Tech.). pp 341-355 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The reaction kinetics attending the electrochemical reduction of HrS in molten sulfide at 830°C are examined. A mixture of sodium and potassium sulfides, melting around 700°C is used throughout, as are graphite electrodes. Potential-step experiments show large exchange currents, on the order of 10kaA/CM2. The reaction rate is dependent on the square root of the HrS pressure. The oxidation reaction, of sulfide to elemental sulfur, is zero-order in HrS pressure. The results are in agreement with mechanisms found by others at lower temperatures. Melting points of several binary alkali sulfides were also determined.

22 **Test results from the high-pressure U-GAS process reactor.** Patel, J.G.; Sandstrom, W.A. (Inst. of Gas Tech.). pp 461-472 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A high-pressure U-GAS Process Development Unit (PDU) has been constructed by the Institute of Gas Technology (IGT) to develop a data base for the ash-agglomerating, fluidized-bed gasification characteristics of different coals. Information obtained from the PDU will complement that from the large 3-foot-diameter U-GAS pilot plant, which has been successfully operated with a variety of American and foreign coals. The PDU system consists of all components for integrated operation, including an 8-inch-diameter reactor that has a nominal feed capacity of 5 tons per day. Following the PDU shakedown, several successful tests have been conducted with Western Kentucky coal. The test results confirm that the PDU can be operated satisfactorily at higher pressures and that the results obtained are useful for evaluating different coals.

23 **Study of fluid flow in an underground coal gasification cavity.** Kennedy, K.M.; Riggs, J.B. (Depart. of Chemical Eng., West Virginia Univ.). pp 451-460 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

When gas injection is either directly into the void space above the rubble pile or, when injection is into a void cavity, transport to exposed side walls is controlled by forced convection under UCG conditions. For the conditions described in #1, a dimensionless correlation has been developed which describes the transport to the side walls. These correlations can be used to estimate transport to the side walls during UCG. When injection is inside the rubble pile, transport to the side wall is significantly hindered while transport to the exposed surface above the rubble pile is free convection controlled.

24 **Roles of catalysis and carbon active sites in the gasification of lignite chars.** Radovic, L.R.; Walker, P.L. Jr.; Jenkins, R.G. (Depart. of Chemical Eng., The Pennsylvania State Univ.). pp 439-450 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A fundamental gasification study has been made on a North Dakota lignite. A very wide range of char reactivities was obtained by varying pyrolysis conditions and pretreatment of the lignite. For

the predominantly uncatalyzed gasification reaction, carbon active site concentration was shown to be a meaningful reactivity index for demineralized chars and for carbons of varying crystallinity. For raw lignite chars, it was shown that CaO is the predominant catalytic species responsible for their high gasification reactivities. Lignite char gasification should be regarded as a catalyzed gas-solid reaction with the catalyst dispersion being the relevant reactivity parameter. When rates are expressed as turnover frequencies, observed reactivity differences of as much as 200-fold are reduced to within one order of magnitude. The commonly observed phenomenon of coal char deactivation with increasing pyrolysis severity was correlated with decreases in carbon active surface area and catalyst dispersion. This fundamental approach was confirmed for chars obtained from potential coal conversion processes.

25 **The High-Temperature Winkler (HTW) process and the Hydrogasification process as Rheinbraun's advanced coal refining processes.** Teggers, H.; Lambertz, J.; Scharf, J.H.; Scharder L.; Velling G. (Rheinishe Braunkohlenwerke AG). pp 426-438 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Based on its large brown coal reserves and good experience gained with ambient pressure Winkler gasifiers the Rheinische Braunkohlenwerke AG has been developing two fluidized-bed gasification processes under pressure: the High-Temperature Winkler (HTW) process for the production of CO + Hr-rich synthesis gases and the Hydrogasification process (HKV) for the production of substitute natural gas (SNG). On basis of good results obtained with test plants for both processes, pilot plants have been operating to satisfaction. For the HTW process additionally a large demonstration plant is already under construction.

26 **Guidelines for evaluation of commercial fossil fuels gasification concepts.** Dillon, R.E.; Floyd, F.M.; Meyer, H.S. (Panhandle Eastern Pipeline Co.). pp 376-382 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

An Ad Hoc Committee of gas industry advisors to the Gas Research Institute (GRI) has prepared new guidelines for evaluating the technical and economic merits of new fossil fuels gasification technologies. These Guidelines are based on over a decade of experience in technology assessment. The mechanism for evaluation is the design and cost estimate of a conceptual coal-to-synthetic natural gas (SNG) plant. To assure that these evaluations are performed on a consistent bases, the Guidelines specify: design and economic assumptions, standards for the process proprietor's design and supporting experimental data, and the analyses performed by a third party evaluation contractor. The economic analysis of the conceptual plant produces a levelized constant dollar SNG cost as a single measure of economic preference. Formal procedures are defined for revisions to accomodate future economic, regulatory, and business changes. Use of the Guidelines will help GRI choose between technology alternatives at both the program and project levels and will help guide technology development. Furthermore, this methodology can be applied to evaluating and guiding development of technologies other than fossil fuels gasification.

27 **Gasification of coal and coal liquefaction residues in the RAG/RCH coal gasification plant at Oberhausen-Holten.** Trondt, M.; Durrfeld, R.; Langhoff, J.; Ruprecht, P.; Cornils. B.; Hibbel, J. (Ruhrkohle Oelund Gas Gmbh). pp 367-375 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Since early 1978 Ruhrkohle Oel und Gas GmbH and Ruhrchemie AG have been operating a Texaco coal gasification demonstration plant at Oberhausen-Holten, W-Germany. By now in more than 16,000 hours of operation 64,000 t of coal (mf) and 16,000 t of coal liquefaction residues have been converted to 161 million mc of synthesisgas. The residues which are the preferred feedstock since mid of 1982 were fed to the gasifier like coal as a solids-water-slurry during a first test period until end of 1983. Now they are gasified in a liquid form at temperatures above their melting point. Both ways are of technical importance for future commercial coal liquefaction plants. Due to the good results in the demonstration plant Ruhrkohle and Ruhrchemie have decided to build a commercial coal gasification plant at Holten, which is now under design. This plant will deliver synthesis-gas and hydrogen for Ruhrchemie's plants from 1986 on using German hard coal as feedstock.

28 **An economic evalutation of SNG and methanol using underground coal gasification.** Siegel, M.M.; James, W.M.; Mason, R.Z.; Gash, B.W.; Barone, S.P. (Williams Brothers Eng. Co.). pp 319-340 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The economics of substitute natural gas (SNG) production from a deep, thick subbituminous coal in the Powder River Basin of Wyoming using underground coal gasification (UCG) technology and conventional aboveground conversion technology was investigated. Additional estimates were also performed on the Base Case to determine the sensitivity of the economics to the following: Plant capacity Coproduction of SNG and methanol Methane content of the raw gas Coal seam depth These studies showed that, the levelized constant dollar (LCD) cost of service price for SNG was $4.47/10fkJ ($4.72/10fBtu) for a plant with a capacity of 7.22 x 10f mc/d (255 x 10fSCFD). Reducing the plant size to one-sixth Base Case resulted in a 77 percent increase in LCD price to $7.92/10fkJ ($8.36/10fBtu). An alternate product slate case, which produced both methanol and SNG, showed that the LCD price of SNG was $4.18/10fkJ ($4.41/10fBtu) when methanol was valued at $5.56/10fkJ ($0.38/gal). Increasing the methane content of the raw gas from 5.6 percent to 11.7 percent resulted in an LCD price of SNG of $3.49/10fkJ ($3.68/10fBtu). Increasing the depth of the coal seam from 213 to 427 m (700 to 1400 ft) at the higher methane content resulted in an LCD price comparable to the 213 m/11.7 percent methane case.

29 **Design and development of the MFR entrained flow PDU.** Coates, R.L.; Shoemaker, H.D. (Mountain Fuel Resources, Inc.). pp 301-308 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Process flow diagrams and a gasification reactor diagram are presented to describe the 30 ton/day process development unit. Experimental data obtained during the first year of operation are presented, including dry coal feeding, coal conversion, and heat recovery data. Conversion data are presented for Utah bituminous coal showing yields of 31-32 SCF/lb of coal, heating values of 273-294 BTU/SCF, and heating value plus heat recovery totaling 84 percent of the coal heating value.

30 **Corrosion and creep of engineering alloys in a coal gasification environment.** Lyle, F.F. Jr.; Page, R.A.; Brown, R.D. (Materials Sci. Depart., Southwest Research Inst.). pp 280-289 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The production of high or medium btu gas from coal requires the use of high-temperature alloys under severe environmental conditions. The proposed gasifiers operate at 700 to 1000\C with complex, aggressive environments containing oxygen, sulfur, carbon, and hydrogen as the reactive species. Under such conditions significant interactions may occur between corrosion and creep, i.e., corrosion may be accelerated by dynamic straining and an increase or decrease in creep resistance may be brought about by reactions with the environment. This paper describes a research program being conducted to evaluate these potential interactions. The results of stress-rupture (SR) tests on three Fe-Cr-Ni alloys in

a high-temperature, high-pressure gaseous environment containing oxygen, sulfur, and carbon are presented and discussed.

31 **Chemistry and mechanism of molten salt catalysts in coal gasification processes.** White, S.H.; Twardoch, U.M. (Research Division, EIC Lab., Inc.). pp 258-267 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Alkali salt catalysts offer ways by which gasification processes can be tailored to produce essential gas products from coal. To achieve such goals, the mechanistic chemistry of the gasification reactions must be fully understood, a difficult task. Considering the alkali metal salt catalysts to be active in the liquid state, the solution chemistry of selected liquid phases has been examined electrochemically in contact with components of the gasification atmospheres. In the presence of oxygen, the formation of oxide and peroxide ions was demonstrated, consistent with atom transfer models for such a system. Under steam/carbon dioxide atmospheres, bicarbonate ions were formed, and it is suggested that these species may also be involved in hydrogen transfer. Evidence for the involvement of surface processes has been a consistent feature of the electrochemical experiments. This has provided a basis for the development of an alternative model for catalysis in terms of corrosion of the coal substrate.

32 **Metallic heat exchangers for coal gasification.** Natesan, K. (Argonne National Lab.). pp 393-405 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A high-temperature corrosion program is being conducted to evaluate the corrosion behavior of selected metallic alloys and coatings in mixed-gas atmospheres for application in heat recovery systems of coal gasification schemes. The experiments conducted with internally air-cooled specimens have established three key variables, namely the gas temperature, metal temperature, and gas chemistry. In addition, the alloy chemistry and exposure time have a strong influence on the corrosion scale morphologies and metal recession rates. The results showed that the scale growth in carbon steel and low- to medium-chromium steels is predominantly linear with time. Selection of these materials will be primarily based upon acceptable corrosion wastage rate. On the other hand, high-chromium alloys can develop thin oxide scales resulting in negligible wastage via corrosion, but are susceptible to accelerated corrosion in mixed-gas atmospheres.

33 **In-situ pyrolysis as a coal characterization technique.** Bogdan, M.; Vastola, F.J. (Depart. of Materials Sci. and Eng., The Pennsylvania State Univ.). pp 383-392 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Focused laser radiation can be utilized to selectively pyrolyze macerals in coal. The resulting pyrolysis products are analyzed by performing the micropyrolysis within the ionization chamber of a time-of-flight mass spectrometer. A series of coals from several provinces, ranging in rank from subbituminous to MVB bituminous, were used to test this technique. Analysis of vitrinite, the major maceral in most coals, indicates the presence of both alkyl and aromatic species. The aromatic species consists of one and two ring aromatic and hydroaromatic structures. The absence of higher molecular weight aromatic species indicates that the skeletal backbone of the vitrinite undergoing pyrolysis is predominantly composed of one and two ring aromatic structures. The greater abundance of alkyl substituted one and two ring aromatic fragments over that of benzene or naphthalene supports a model where aromatic groups are linked by short aliphatic bridges, where the major breakage of bonds on pyrolysis is between the weaker alkyl C-C bonds rather than the stronger alkyl-aryl C-C bonds.

0105 By-products

REFER ALSO TO CITATION(S) 132

0106 Properties

REFER ALSO TO CITATION(S) 17, 33, 66, 70, 71, 74, 1023, 1267

34 **(CEGB-TPRD-L—2666-N84) Distribution of flame reacted lead species in ash and chimney solids.** Raask, E.; Bhaskar, M.C. (Central Electricity Generating Board, Leatherhead (UK). Technology Planning and Research Div.). 1984. 35p. Central Electricity Generating Board, Leatherhead (UK). Technology Planning and Research Div.

British power station coals contain, on average, 25 ppm lead in the form of the sulphide (PbS), partly associated with pyrite mineral and partly dispersed in the fuel substance with clay material. The melting volatilization and fume forming characteristics of coal lead species were investigated by heating ground samples of galena (PbS) mineral in a heating microscope and in a high temperature thermo-balance. The results were used to assess the behaviour of coal lead species in a pulverized fuel flame. Samples of combustion chamber slag, precipitator ash and chimney solids were taken for lead analysis from a 500 MW boiler burning a mixture of East Midlands coal. Over 80 per cent of coal lead was captured with the pulverized fuel ash in the electrical precipitators, over 10 per cent was in the boiler slag and only about 2 per cent of the fuel lead was emitted with the chimney solids. The coal contained 13 ppm lead and thus the chimney fraction accounted for 0.3 ppm of the fuel lead. (37 refs.)

35 (CONF-840408—, pp 481-489) **Instrumental neutron activation analysis in the measurement of trace element distribution at two coal conversion plants.** Roseberry, L.M.; Dyer, F.F. (Oak Ridge National Lab., TN). Apr 1984. NTIS, PC A99/MF A01. File Number DE84017348. Contract W-7405-ENG-26.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

Instrumental Neutron Activation Analysis has been used to measure trace element distribution in coal and process samples from two coal conversion plants: the low BTU gasification process at the University of Minnesota at Duluth (UMD) and the direct liquefaction process at the H-Coal pilot plant in Catlettsburg, Kentucky (HCOAL). Most of the trace elements present in coal are highly concentrated in the solid wastes: bottom ash (UMD) and vacuum bottoms (H-Coal). Significant percentages of the elements, Sb, As, Br, Cl, Cr, Co, and Se, were found in the UMD gasifier tar, which is recovered from the product gas line as a waste. Mass balance calculations of the H-Coal liquefaction process do not account for the volatile elements (As, Cl, Se, Hg, Cd, Be, and Ni) in the liquid and solid waste products.

36 **(DOE/PC/60015—30) Separation and characterization of coal derived components, 1 July-30 September 1985.** Hurtubise, R.J.; Silver, H.F. (Wyoming Univ., Laramie (USA). Office of Univ. Research). 9 Oct 1985. Contract AC22-83PC60015. 80p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001317.

The compositional data obtained from chloroform-soluble preasphaltenes of Kentucky 9/14 coal-derived SRC (F-51) has been evaluated and written in rough manuscript form. The low carbon content and low volatility for several fractions isolated from Wyodak coal-derived SRC (F-45) appears to be related to the iron content of the mobile phases used in conjunction with silica gel. A method has been developed for the separation of nitrogen compounds from oils and asphaltenes. The method involves the Chromasorb T-basic alumina procedure to obtian nitrogen rich fractions, removal of polycyclic aromatic hydrocarbons with silica gel, and separation of basic and nonbasic nitrogen compounds with a bonded-amino phase column. Finally, four manuscripts on various topics related to the project are being reviewed. The following two

reports in the appendices have been processed separately for inclusion in the Energy Data Base: "Separation of aromatic nitrogen compounds into compound-class types using normal-phase high performance liquid chromatography"; and "Solvent composition effects in the normal-phase liquid chromatography of nitrogen heterocycles and hydroxyl aromatics on a nitrophenyl stationary phase". 10 figs., 1 tab.

37 (DOE/PC/60015—30, pp 28, Appendix A) **Separation of aromatic nitrogen compounds into compound-class types using normal-phase high performance liquid chromatography.** Scolla, P.L.; Hurtubise, R.J. 9 Oct 1985. NTIS, PC A05/MF A01. File Number DE86001317.

In Separation and characterization of coal derived components, 1 July-30 September 1985.

Normal-phase high performance liquid chromatography (HPLC) was used for the separation of aromatic nitrogen model compounds known to be present in solvent refined coal (SRC) liquids. Three commercially available stationary phases, silica, cyano-silica, and amino-silica, were investigated with model compounds and various n-heptane:2-propanol mobile phases. Only the amino-silica stationary phase with a 85:15 (v:v) n-heptane:2-propanol mobile phase was able to separate the aromatic nitrogen containing model compounds into three main compound-class groups. 28 refs., 3 figs., 1 tab.

38 (DOE/PC/70006—T4) **Enthalpy and phase behavior of coal derived liquid mixtures. Technical progress report, July-September 1985.** Yesavage, V.F.; Kidnay, A.J. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 31 Oct 1985. Contract FG22-84PC70006. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002049.

On July 15, 1984, work was initiated on a program to study the enthalpy and phase behavior of coal derived liquid model compound mixtures. During the fifth quarter, preliminary enthalpy measurements for the 50/50 mole percent m-cresol/tetralin binary mixture have almost been completed and figure illustrating the preliminary results have been included in this report. Vapor liquid equilibria measurements for the m-cresol/quinoline system have been completed for four isotherms. Results have been included in this report. 6 refs., 13 figs., 4 tabs.

39 (DOE/PC/70799—T3) **Identification of nonvolatile coal derived products via chromatography coupled with on-line FTIR detection. Quarterly progress report, June 1-August 31, 1985.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Oct 1985. Contract FG22-84PC70799. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001266.

One problem in extending Fourier Transform Infrared Spectrometric (FTIR) detection to Supercritical Fluid Chromatography (SFC) or any other chromatography is insufficient detector sensitivity. Although the work done to this point has been encouraging, a need for further optimization of the interface exists. An obvious means of improving the sensitivity in the IR is through an increase in the pathlength of the flow cell as long as the solvent allows sufficient optical transmittance. This increase should enhance the signal-to-noise ratio of the spectra obtained. However, too great a pathlength may lead to (1) a decrease in the width of the IR window region, (2) a substantial drop in the optical efficiency, and/or (3) a decrease in overall resolution and integrity of the on-line spectra. In this paper we present SFC results employing two flow cells, differing in length cell wall material, cell pathlength and flow geometry and two mobile phases (CO_2, Freon 23) with both uv and FTIR on-line detection. In doing so, we also show the eluting characteristics of basic nitrogen compounds on a packed bonded phase silica column and compare retention characteristics of a model separation using the two different supercritical mobile phases. A sensitivity study with a weak IR absorbing compound employing more nearly optimal chromatographic parameters than spectrometric parameters is discussed wherein the two cells are compared. 11 refs., 11 figs.

40 (DOE/PC/70809—T3) **Microbial screening test for lignite degradation. Quarterly progress report No. 3, July 1-September 30, 1985.** Yen, T.F. (University of Southern California, Los Angeles (USA)). 1985. Contract FG22-84PC70809. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001104.

Degradation of Beulah std No. 3 lignite was carried out by means of cupric oxidation, modified-autoclaved-cupric oxidation, sodium dichromate oxidation, and also by biological methods. Assessment of the yield of alkaline-soluble and methanol soluble products of both cupric oxidation and modified cupric oxidation (on a moisture-free and ash-free basis) was carried out by both ion chromatography and gel permeation chromatography. Fractionation of lignite for natural-uninoculated-biological growth resulted in no growth for both benzene-methanol fraction and alkaline filtrate fraction, whereas that of alkaline geletinous fraction resulted in positive growth of unidentified white-rot fungi. Acclimation of Polyporus versicolor to lignite was attempted. 10 refs.

41 (ERP/MSL—84-136) **Characterization of reaction products in a fluid bed coal combustion process by thermal analysis.** Mikhail, S.A. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Oct 1984. 18p. Canada Centre for Mineral and Technology, Ottawa, Ontario.

Thermogravimetry (TG) was used to study representative samples from a fluid-bed coal combustion in which limestone is added to interact with evolving sulphur dioxide. Differential thermal analysis (DTA) was used concurrently with TG. Proximate analysis of the coal was also carried out by thermogravimetry. Thermal analysis of the samples in air and in argon indicated the presence of $Ca(OH)_2$ and minor amounts of $CaCO_3$ in the bed material, and coal, $CaCO_3$, $CaSO_4$, and $Ca(OH)_2$ in material collected from the baghouse dust. Useful information was obtained which may lead to a better understanding of the operation of the combustor.

42 (IS-M—557) **Study of coal oxidation kinetics by Fourier Transform Infrared-Photoacoustic Spectroscopy (FTIR-PAS).** Chien, P.L.; Markuszewski, R.; Araghi, H.G.; McClelland, J.F. (Ames Lab., IA (USA)). 1985. Contract W-7405-ENG-82. 4p. (CONF-851003—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85017345.

From Conference on coal science; Sydney, Australia (28 Oct 1985).

Fourier Transform Infrared-Photoacoustic Spectroscopy (FTIR-PAS) was used to measure oxidation-induced changes in IR absorbance bands of coal during exposure to air in an oven for up to 200 h. Studies were conducted at oxidation temperatures of 110, 120, 130, and 140°C on raw Illinois No. 6 coal and at 140°C on coals treated with HCl or $CaCl_2$ aqueous solutions in order to vary the concentration of exchangeable cations present. 7 refs., 5 figs.

43 (STEV-FBA—85-7) **Identification of the crystalline parts in peat ashes.** Sandstroem, M.; Welander, M.; Hansen, E.; Desselberger, I. (Statens Energiverk, Stockholm (Sweden)). 1984. 44p. (In Swedish). NTIS (US Sales Only), PC A03. File Number DE85752740.

Six peat ashes from different places in Sweden have been investigated by x-ray diffraction in order to identify the crystalline parts. Only qualitative identifications have been performed. The identifications were based on the PDF-registry (Powder Diffraction File). All samples showed magnetic properties but only in two samples a non-magnetic fraction could be separated. Crystalline iron oxides, magnetite, hematite, α-quarts, silicates of plagioclase type, sodium calcium aluminium silicates, and calcium aluminium silicates were found in all samples.

44 **Reaction of silicon carbide with product gases of coal combustion.** Dragoo, A.L.; Waring, J.L. pp 161-176 of Proceedings of the 7th annual conference on materials for coal conversion and utilization. Gaithersburg, MD; National Bureau of Standards (1982). (CONF-821145—).

From 7. materials for coal conversion and utilization conference; Gaithersburg, MD, USA (16 Nov 1982).

The reactions of commercially manufactured silicon carbide ceramics--two materials without free silicon and two materials with free silicon(siliconized)--with air, N_2 + SO_2, and a simulated coal-combustion gas containing about seven volume percent O_2 were investigated. Samples were annealed in air and N_2 + SO_2 at 1400C for successive annealing times up to a total time of 12 hours. Samples were annealed in the simulated combustion gas at 1350C for four hours. For anneals in air and in simulated combustion gas, low critobalite and, possibly, some tridymite were the main reaction products. The presence of SO_2 in N_2 appears to promote the nitridation of the silicon carbide ceramics.

45 **Thermodynamic activity and vapor pressure models for silicate systems including coal slags.** Hastie, J.W.; Bonnell, D.W.; Plante, E.R.; Horton, W.S. pp 265-280 of Proceedings of the 7th annual conference on materials for coal conversion and utilization. Gaithersburg, MD; National Bureau of Standards (1982). (CONF-821145—).

From 7. materials for coal conversion and utilization conference; Gaithersburg, MD, USA (16 Nov 1982).

A new modeling approach is described for thermodynamic predictions of multicomponent, multiphase high-temperature silicate systems including coal slags. The model, which attributes negative deviations from ideal-solution behavior to the formation of complex liquids and solids, is demonstrated for quarternary systems containing K_2O, Al_2O_3, CaO, and SiO_2. Good agreement between the model predictions and experimental vapor pressure data is found.

0108 Waste Management

REFER ALSO TO CITATION(S) 8, 10, 64, 82, 462, 463, 1301

46 **(DOE/MC/21108—T1) Management of coal waste by energy recovery: mild gasification/flash pyrolysis of coal preparation wastes. Topical report No. one: literature review.** McCown, F.E.; Gillespie, B.L. (UCC Research Corp., Bristol, VA (USA)). 4 Apr 1985. Contract AC21-84MC21108. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001588.

The purpose of this literature review is to collect and assess the available literature of the management of coal preparation wastes. Three areas in particular will be examined. They are: (1) current and projected future production of coal preparation wastes, (2) characteristics of regulated constituents present in such wastes, and (3) current and potential future techniques available for managing such wastes. With coal production figures steadily rising there is a need to know how much coal preparation waste is generated now, and how much will be generated in the future. With nearly all the naturally-occurring elements present in coal wastes, elements released in harmful amounts are identified, and current and future techniques for handling harmful effluents are discussed.

47 **(ORNL/TM—9535) Releases of coal liquefaction products in inland waters.** Giddings, J.M.; Herbes, S.E.; Gehrs, C.W. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001467.

Chemical and physical differences between coal-derived oils (especially those produced by direct liquefaction processes) and crude or refined petroleum would result in significant differences in the behavior of the oils after release into rivers or lakes. Phenolic compounds are abundant in many coal liquids but not in petroleum; these compounds dissolve rapidly in water and are toxic to aquatic life. Polycyclic aromatic hydrocarbons, aromatic amines, and other insoluble oil constituents could accumulate in bottom sediments, from which they could be taken up by organisms and cause long-term ecological effects. Through laboratory studies, simulation modeling, and field experiments, information has been developed that supports a preliminary evaluation of the potential environmental impacts of coal liquid spills. Releases of crude products into large rivers would probably cause relatively little immediate ecological damage, but spills in lakes, embayments, and other semienclosed water bodies could have serious effects. Product upgrading by hydrotreatment or distillation can be expected to reduce the environmental hazards of coal-derived oils.

48 **(STEV-FBA—84-7) Similarities between lime and limestone in wet-dry scrubbing.** Klingspor, J.; Stroemberg, A.M.; Karlsson, H.T.; Bjerle, J. (Statens Energiverk, Stockholm (Sweden)). 1984. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85752728.

The dry reaction between SO_2 and lime or calcium carbonate has been investigated at low temerature for application in wet-dry scrubbing. The intention of the study was to compare the reactivity of lime and calcium carbonate when reacting with SO_2. The reactivity is mainly dependent of the adsorption capacity of water vapor, the BET-surface area, the realtive humidity and the sorbent utilization. The study has revealed that when relating the sorption capacity and the reactivity per unit of BET-surface area, they coincide for lime and calcium carbonate. Furthermore, the same mechanism can be applied for utilization of the two compounds.

49 **(STEV-FBA—85-6) Handling and disposal of peat ashes.** Meijer, J.E. (Statens Energiverk, Stockholm (Sweden)). Oct 1984. 62p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752739.

The report describes the handling and disposal of peat ashes at nine peat fired heating plants in Sweden and Finland. The operation conditions and milieu problems have also been studied.

50 **(STEV-FBA—85-11) Mercury in peat ashes.** Lindqvist, O. (Statens Energiverk, Stockholm (Sweden)). Dec 1984. 25p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752741.

Measurements of mercury in peat ashes have been carried out. 16 samples from different heating plants were analysed. Both the total amount and volatile part of mercury were determined. The results show that in some cases a great deal of the mercury will stay in the bottom ashes. A plausible explanation is that stabil mercury compounds (HgSe) are enclosed in bigger particles. Very little or nothing of the mercury will evaporate from dry ashes under normal temperature conditions. Mercury in suspended form can be spread from the refuse dumps by the runoff water. Very little mercury is dissolved in the runoff water.

51 **(TVA/OP/EDT—84/37) Shawnee flue gas desulfurization computer model users manual.** Sudhoff, F.A.; Torstrick, R.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Mar 1985. 262p. (EPA—600/8-85-006). NTIS, PC A12/MF A01. File Number DE86900143.

In conjunction with the US Enviromental Protection Agency sponsored Shawnee test program, Bechtel National, Inc., and the Tennessee Valley Authority jointly developed a computer model capable of projecting preliminary design and economics for lime- and limestone-scrubbing flue gas desulfurization systems. The model is capable of projecting relative economics for spray tower, turbulent contact absorber, and venturi-spray tower scrubbing options. It may be used to project the effect on system design and economics of variations in required SO_2 removal, scrubber operating parameters [gas velocity, liquid-to-gas (L/G) ration, alkali stoichiometry, liquor hold time in slurry recirculation tanks], reheat temperature, and scrubber bypass. It may also be used to evaluate alternative waste disposal methods or additives (MgO or adipic acid) on costs for the selected process. Although the model is not intended to project the economics of an individual system to a high degree of accuracy, it allows prospective users to quickly project comparative design and costs for limestone and lime case variations on a common design and cost basis. The users manual provides a general descripton of the Shawnee FGD computer model and detailed instructions for its use. It describes and explains the user-supplied input data which are required such as boiler size, coal characteristics, and SO_2 removal requirments. Output includes a material balance, equipment list, and detailed capital investment and annual revenue requirements. The users manual provides information concerning the use of the overall model as well as sample runs to serve as a guide to prospective users in identifying applications. The FORTRAN-based model is maintained by TVA, from whom copies or individual runs are available. 25 refs., 3 figs., 36 tabs.

52 **(TVA/PUB—86/4) Laboratory testing of potential utilization of AFBC wastes and other fossil fuel waste in the production of low strength concretes for mining applications.** Rose, J.G. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). Mar 1985. 108p. NTIS, PC A06/MF A01. File Number DE86900098.

The potential of utilizing AFBC wastes, either separately or in combination with other coal wastes, to produce a low strength concrete for mining related applications was evaluated. Specifically, the first phase of the research was directed at the following: Coarse Aggregate Replacement - Coal Refuse; Fine Aggregate Replacement - AFBC Spent Bed Material; and Cement Replacement - Power Plant Fly Ash - AFBC Baghouse and Cyclone particulate. In addition, research was directed at examining the effect of acid mine drainage (AMD) on low strength concretes made from the above mentioned wastes. The second phase of the research was to center on the field demonstration of auger hole grouting for entry support and coal-crete pillar emplacement for secondary coal recovery and subsidence control. 58 refs., 16 figs., 32 tabs.

53 **Treatment of aqueous waste streams from KRW energy systems coal gasification technology.** Winton, S.L.; Page, G.C.; French, W.E.; Evans, J.M.; Buvinger, B.J.; Rhodes, W.J. (Radian Corp.). pp 473-486 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Ash agglomerating fluidized-bed coal gasification technology has developed to the point where commercial-scale systems are being planned. The KRW Energy Systems (KRW) coal gasification process (formerly called the Westinghouse gasification process) is representative of this technology and has been the subject of extensive environmental, health, and safety evaluations. The Department of Energy (Morgantown Energy Technology Center), the Gas Research Institute, and the Environmental Protection Agency (Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina) have sponsored a bench-scale evaluation to determine the extent to which process wastewaters from the KRW gasification process are treatable using commercially proven wastewater treatment technology. The program was conducted in cooperation with KRW which provided wastewater samples, process information, and technical review. The treatment processes considered in this evalution were suspended solids removal, steam stripping, cyanide conversion, and biological oxidation.

54 **Coal fines utilization and disposal.** Hubbard, D.A.; Meyer, H.S.; Leppin, D. (Kellogg Rust Synfuels, Inc.). pp 268-279 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

An excess of coal fines usually exists when fixed-bed gasifiers are used in a coal-to-SNG plant, since these gasifiers cannot accept more than a small fraction of the fines typically present in run-of-mine (ROM) coal, and the remaining fines greatly outweigh the plant's fuel requirements. Potential methods to dispose of the fines or to utilize them within the SNG plant include sale of the fines as fuel to a power plant, burial of the fines if no market exists, mechanical agglomeration of fines to form larger particles that can be used as fixed-bed gasifier feedstock and direct gasification of the fines by using other gasification processes. A final option involves purchase of pre-sized coal with a very low fines content. Material/energy balances and economics for each of these cases have been developed on a consistent basis for a large coal-to-SNG plant using North Dakota lignite as feedstock. The least technical risk exists for the options with fines being sold or buried and for purchase of sized coal. Economic analysis shows the mechanical agglomeration routes have the least cost SNG. The mechanical agglomeration routes are the least proven of the various routes, however, and as such have the least commercial potential.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 62

55 **(DOE/EV/10256—T5) Research on revegetation of Alaskan coal mine spoils. Section I - Plant material studies. Section II - Wildlife habitat use studies. Progress report, 1983.** Mitchell, W.W.; Elliott, C.L.; McKendrick, J.D. (Alaska Univ., Palmer (USA). Alaska Agricultural and Forestry Experiment Station). 1983. Contract AT06-79EV10256. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001212.

Seedings of plant materials at stripmine locations were conducted at the Usibelli mine near Healy, at the abandoned Jonesville mine in the Matanuska Valley, and in the undeveloped Beluga coal field in the foothills of the Alaska Range. Grasses enduring best over a variety of conditions include entries of red fescue, sheep fescue, and tuffed hairgrass. Observations were made on occurrences of several big game mammals and their habitat uses on the Usibelli mine property. 14 refs., 19 tabs. (ACR)

56 **(PB—85-210037/XAB) Lime and limestone market for sulfur removal: potential for 1992. Illinois mineral notes.** Bhagwat, S.B. (Illinois State Geological Survey, Champaign (USA)). 1985. 19p. (IL/SGS/IMN—90). NTIS, PC A02/MF A01.

In the United States, the market for lime and limestone declined in the 1970s and early 1980s; however, following the passage of clean air regulations, a small niche in the market developed when lime and limestone became important components of processes used to reduce the sulfur dioxide emissions that result from burning coal. No demand for lime and limestone for sulfur removal existed in 1974, and tremendous growth was predicted. However, by 1983 sales of lime and limestone only achieved 8% of the predicted potential. The demand did not reach the projected level partly because of the availability of low-sulfur fuels, the differences in industrial growth rates from state to state, the flexibility in implementation of the Clean Air Act, and the demographics of the country.

57 **(PB—85-213429/XAB) Evaluation of environmental stress imposed by a coal-ash effluent: Wisconsin power plant impact study.** Webster, K.E.; Forbes, A.M.; Magnuson, J.L. (Madison Gas and Electric Co., WI (USA); Wisconsin Univ., Madison (USA). Center for Limnology; Wisconsin Dept. of Natural Resources, Madison (USA); Wisconsin Public Service Corp., Green Bay (USA)). Jun 1985. 66p. NTIS, PC A04/MF A01.

Effluent discharged from the coal-ash settling basin of the Columbia Generating Station (Wisconsin) modified water chemistry (increased trace metal concentrations, suspended solids and dissolved materials) and substrate quality (precipitation of chemical floc) in the receiving stream, the ash pit drain. To test the hypothesis that habitat avoidance could account for declines in macroinvertebrate density observed after discharge began, drift rates of two species were measured in laboratory streams containing combinations of reference and coal-ash-modified substrate and water. Contrary to the hypothesis, drift was uniformly lower in laboratory streams containing modified substrate and/or water compared to the reference condition for Gammarus pseudolimnaeus and Asellus racovitzai.

58 **(PB—85-214666/XAB) Toxicological studies on aquatic contaminants originating from coal production and utilization: the induction of tolerance to silver in laboratory populations of fish and the chronic toxicity of nickel to fish early-life stages. Research report July 1983-August 1984.** Birge, W.J.; Black, J.A.; Hobson, J.F.; Westerman, A.G.; Short, T.M. (Kentucky Water Resources Research Inst., Lexington (USA)). Aug 1984. 36p. (RR—151). NTIS, PC A03/MF A01.

Aquatic toxicity studies were performed on two important coal-derived contaminants, silver and nickel. Silver was investigated with regard to metal-induced tolerance in laboratory populations of the fathead minnow (Pimephales promelas). Fish were exposed to acute silver concentrations following acclimation to sublethal ex-

posures of this metal. Based on median lethal times (LT50), animals receiving 14 days prior exposure to 1.5 and 15 micrograms Ag/l were three to four times more resistant to silver than were previously unexposed organisms. The metal-induced resistance was not a sustained response. After organisms that had been acclimated to 15 micrograms/l had been transferred to clean water for two weeks, LT50 values determined with these animals were statistically indistinguishable from those calculated with non-acclimated control fish. With respect to nickel, a 32-day continuous-flow test was performed with the fathead minnow. Nickel was administered in duplicate at six exposure concentrations ranging from 0.038 to 0.733 mg/l in medium-hard water (100 mg CaCO3/l).

59 **(PB—85-224640/XAB) Testing of wall-fired furnaces to reduce emissions of NO/sub x/ and SO/sub x/. Volume 2. Appendices. Final report, August 1982-November 1983.** Case, P.L.; Ho, L.; Clark, W.D.; Kau, E.; Pershing, D.W. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jun 1985. 251p. NTIS, PC A12/MF A01.

The report gives results of a study to clarify the processes that control sulfur capture by dry sorbents injected directly into a pulverized-coal-fired system, and to develop methods for generalizing data from one test furnace to another and from test facilities to fired application. Most experiments were conducted in a 1 million Btu/hr down-fired furnace to determine the effects of: fuel type, sorbent type, injection location, peak flame temperature, SO_2 concentration, and burner zone stoichiometry. Conclusions of the study include: (1) the concentration of SO_2 in the natural-gas-fired tests had a slight effect on sulfur capture, increasing capture at Ca/S = 2 from 26% at 500 ppm to 40% at 3500 ppm SO_2; (2) the concentration of mineral matter in the system had a very strong impact on capture at all SO_2 concentrations and Ca/S ratios tested; (3) injecting the sorbent downstream from the main flame resulted in improved utilization in coal flames; and (4) the effect of sorbent type on capture with a given fuel was dependent on the firing conditions - including sorbent injection location and thermal conditions (the hydrated limes seemed to be most sensitive to thermal conditions and the Vicron limestone least sensitive). Dolomite gave the highest capture with all of the fuels tested.

60 **(PB—85-228864/XAB) Underground mine monitoring and control testing criteria. Open File report.** Nutter, R.S.; Chapman, R.S.; Kissel, A.M.; Winkelmann, C.A.; Voltz, W.R. (West Virginia Univ., Morgantown (USA). Dept. of Electrical Engineering). 30 Jun 1984. 159p. NTIS, PC A08/MF A01.

The proliferation of computer-based monitoring and control systems for underground coal mines has created the need for criteria to be used in evaluating the performance of the systems. The report contains the findings and conclusions of research on the development of test criteria for monitoring and control systems. The design of a test facility for control systems performance measurement of monitoring and control systems is presented. Tests were conducted and the results were used to develop recommended criteria. The implementation of the test facility, test conclusions, and resultant objectives are described in the executive summary. The appendix presents the detailed design of test facility hardware and software.

0110 Reserves And Exploration

61 **Preliminary study of coal seam permeability in the Piceance, San Juan, and Warrior basins.** Koenig, R.A.; Bell, G.J.; Way, S.C. (In-Situ, Inc.). pp 247-256 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The limited data available give a range of values for permeability in coal formations of the Piceance, San Juan, and Warrior basins. This information is useful for initial site selection and for designing transient pressure tests which can give more complete data needed for site evaluation, hydraulic fracture design, wellfield design for optimal dewatering, and more thorough understanding of the hydrologic behavior of coalbed methane reservoirs. Hydrologic data needed includes well location, lithology of completed intervals, permeability, porosity, compressibility, depth of burial, reservoir pressure, static water level, directional permeability, etc. Field work designed to obtain more precise values of all the hydrologic parameters should have a high priority in developing technology for coalbed methane drainage. Although more deeply buried coalbeds are less permeable, and thus produce gas more slowly, they may also contain more mature coals of higher rank and greater gas content. Additional data combined with computer modeling studies are needed to find the optimal combination of quantity of gas resource and potential productivity.

0120 Mining

REFER ALSO TO CITATION(S) 80

62 **(DOE/EV/10256—T4) Revegetation of Alaskan coal mine spoils. Final report.** Mitchell, W.W.; Ping, C.L.; Mitchell, G.A.; Michaelson, G.J.; Kaija, K.J. (Alaska Univ., Palmer (USA). Alaska Agricultural and Forestry Experiment Station). May 1985. Contract AT06-79EV10256. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001163.

Minespoil reclamation studies were commenced in 1980 in three coal fields in Alaska. The studies included plant adaptability trials, fertilizer trails, characterization and classification of soils, and wildlife investigations. This report concerns activities undertaken through the 1984 research season regarding first three areas of study. Studies were conducted in the Nenana coal field at the Usibelli coal mine, in the Matanuska coal field at the abandoned Jonesville mine, and in the undeveloped Beluga coal field. Most of the work was conducted at the Usibelli coal mine, the largest commercial mine currently active in Alaska. The Usibelli mine is located at about 64 N latitude in the continental interior climatic region of Alaska south of Fairbanks. It spans the upper boreal forested to low alpine zones, about 460 to 760 meters elevtion. The Jonesville mine, now idle, is located near 62 N in the boreal forested zone of southcentral Alaska, about 325 meters elevation, in the upper Cook Inlet region. The Beluga coal field extends from the shores of the Cook Inlet on a gradual incline to the ramparts of the Alaska Range, transecting the forested and alpine zones about 61 N. The State of Alaska recently adopted surface coal mine regulations with requirements for mine operators to follow for the permitting process. The Alaska Division of mining is in the process of determining how these regulations are to be implemented. The results of the studies reported on herein have figured prominently in discussions between the Division and mine operators on the implementation of the new regulations. 1 fig., 26 tabs.

63 **(ECE/COAL—90) Development of optimum technological flowsheets for line production at opencast workings.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). Jun 1985. 12p. United Nations Economic Commission for Europe.

Contains the report submitted by the Group of Experts on Open-cast Mines at its fourth session in Ankara, Turkey, on 9-13 May 1983. Discusses: geological and technical mining conditions for continuous (line) production; winning technology; and solutions proposed to transport problems. Information was submitted by the German Democratic Republic, Czechoslovakia and Poland.

64 **(ECE/COAL—91) Ways and means of dewatering opencast mines, particularly at great depth or in difficult mining conditions.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). Jun 1985. 10p. United Nations Economic Commission for Europe.

Contains the report submitted by the Group of Experts on Open-cast Mines at its fourth session in Ankara, Turkey, on 9-13 May 1983. Reviews the need for and the importance of dewatering in opencast mining; exploration of hydrogeological conditions; dewatering techniques (filter well dewatering of large areas, road/fall-filter dewatering, surface dewatering by ditches); and special techniques of dewatering (dewatering of spoil dumps, horizontal boreholes, waterproofing wells).

65 **(ERP/CRL—84-29) Conversion of advancing longwall to retreat longwall: a review report.** Haslett, G.A. (Department of Energy, Mines and Resources, Cape Breton, Nova Scotia (Canada). Cape Breton Coal Research Lab.). Oct 1984. 21p. Department of Energy, Mines and Resources, Cape Breton, Nova Scotia (Canada). Cape Breton Coal Research Laboratory.

Longwall retreat mining employing the latest technology can outstrip any other system in the fields of concentrated production and costs. The system has nevertheless many modifications that acknowledge site specific conditions. A review of the constraints on the system is given together with a number of panel layouts including some that utilize longwall advancing in conjunction with longwall retreating. (7 refs.)

66 **(ERP/CRL—84-30) Use of a microprocessor controlled coal analyzer to evaluate mine roadway dust samples.** Kennedy, D.J.; Bonnell, G. (Department of Energy, Mines and Resources, Cape Breton, Nova Scotia (Canada). Cape Breton Coal Research Lab.). Oct 1984. 14p. Department of Energy, Mines and Resources, Cape Breton, Nova Scotia (Canada). Cape Breton Coal Research Laboratory.

The current method used to render mine roadway dust nonexplosive in the Sydney Coalfield is the application of fine inert limestone dust. Sampling of mine roadway dust is done on a regular basis to ensure that sufficient inert dust is present to prevent a coal dust explosion from propagating. This report describes the use of Fischer Model 490 Coal Analyzer for analyzing mine roadway dust samples. Automated coal analyzers incorporating electronic balances and microprocessors are well suited for performing low temperature ash analysis on mine roadway dust samples. On the basis of these preliminary analyses, automated low temperature ashing offers a rapid accurate alternative to the more classical labor intensive methods.

67 **(PB—85-222420/XAB) Respirable dust control on longwall mining operations in the United States. Informational report.** Mundell, R.L.; Jankowski, R.A.; Ondrey, R.S.; Tomb, T.F. (Mine Safety and Health Administration, Arlington, VA (USA)). 1984. 29p. (IR—1151). NTIS, PC A03/MF A01.

The paper discusses the results of respirable dust studies conducted on United States longwall mining operations in 1972 and 1978. Prevalent engineering control methods (ventilation, water application and use of machine cutting parameters) and administrative controls for minimizing employees respirable dust exposures are discussed. Current research efforts for the control of respirable dust on longwall mining operations are reviewed.

0130 Transport And Handling

68 **(BNL—37048) Carbon dioxide/water for coal beneficiation.** Sapienza, R.; Butcher, T.; Slegeir, W.; Healy, F. (Brookhaven National Lab., Upton, NY (USA)). Aug 1985. Contract AC02-76CH00016. 18p. (CONF-840805—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001735.

From 188. meeting of the American Chemical Society; Philadelphia, PA, USA (26 Aug 1984).

Pressurized carbon dioxide/water solvents affect the chemical and physical properties of coal to provide a method of simultaneous cleaning and fracturing. The synergistic interaction of these two inexpensive reagents causes the selective solubilization of the alkali and alkaline earth mineral matter in the coal and the swelling of the coal matrix which weakens the coal structure. Significant improvements in coal grindability with high retention of energy content have been achieved. 11 refs., 3 figs., 7 tabs.

69 **(DOE/METC—85/4022) Techniques and relative energy requirements for fine-coal grinding.** Notestein, J.E. (USDOE Morgantown Energy Technology Center, WV). May 1982. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013612.

The Coal Grinding Task Group basically characterized coal grinding technology (June 1982) with an emphasis on identifying any needs related to producing very fine coal (<325 mesh). The underlying assumption was that future coal usage in non-designed-for-coal-applications will depend on coal being free of ash (and perhaps sulfur), or capable of behaving in a fluid-like manner, or both. One common step toward both of these attributes is the fine grinding of coal. Of the various types of fine grinding devices identified, two were found to appear superior from the standpoints of energy consumption and operational lifetime. These are the attritor (a special embodiment of which is the Drais Direct Dispersion System), and the Fluid Energy Reduction Mill. There are two widely regarded theories that relate energy consumption to product particle size. The first was developed by Rittinger about 1867 and holds that, "The work required to reduce particle size is directly proportional to the new surface area produced." The second theory, developed by Kick in 1885, was based on plastic deformation, "The work required for crushing a given quantity of material is constant for the same reduction ratio, irrespective of the original size." Neither of these theories has been found to be exactly applicable; however, the Rittinger theory appears reasonably usable in the range of 10 to 100 microns. The Kick theory appears better matched to larger particle sizes. Another approach, known as the Bond theory, fits between the two. The conclusion is that cost, scale of available hardware and technology, and the ability to make reliable predictions relative to producing any UCCWM that requires particles below the 10-micron size should be approached with great caution.

70 **(DOE/PC/60045—T7) Integration of advanced preparation with coal liquefaction. Final technical progress report, October 1, 1983-September 30, 1985.** Longanbach, J.R.; Steedman, W.G.; Muralidhara, H.S.; Folsom, D.W.; Droege, J.W. (Battelle Columbus Labs., OH (USA)). 30 Sep 1985. Contract AC22-83PC60045. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85018268.

A four step process has been investigated to prepare coal for direct liquefaction. The steps are (1) wet grinding of coal in water, (2) removal of chlorine, sodium and calcium, release of mineral matter and incorporation, if desired, of a disposable catalyst by hot-water treatment at elevated pressure, (3) oil agglomeration using a liquefaction product fraction to dewater and deash coal while retaining pyrite, and (4) solvent drying of coal agglomerates to minimize oxidation of coal, improve coal liquefaction reactivity, save energy and prepare the coal/solvent slurry for liquefaction. Fresh Illinois No. 6 and Wyodak upper and lower seam coal samples were obtained from the mine. The Illinois No. 6 and Wyodak upper seam coals were used in this study. They were analyzed before and after wet grinding. Some chlorine is lost from Illinois No. 6 coal and ash content increases, probably due to wear on the iron balls in the ball mill. Very fine grinding did not release more than about 50% of the ash such that it could be separated from the coal. Wet grinding did not completely protect the coal surface from oxidation. Coal derived liquid samples were obtained from the C.E. Lummus ITSL direct liquefaction process. These include -343 C products and +343 C recycle solvents prepared from both Illinois No. 6 and Wyodak coals and a doubly hydrogenated product fraction for use in the oil agglomeration studies. Each fraction was analyzed and distilled into 50 C cuts for use in the oil agglomeration studies. The recycle solvents were also used in the microautoclave liquefaction reactivity tests. 14 refs., 45 figs., 37 tabs.

71 **(DOE/PC/70796—5) Effect of maceral properties on the comminution of coal. Technical progress report, July 1, 1985-September 30, 1985.** Bodily, D.M. (Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering). 1985. Contract FG22-84PC70796. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001764.

Sequential swelling experiments were conducted on five coals. Results of these experiments are shown for two of these coals. Similar results were obtained for the other three coals tested. The swelling of the coals in four solvents, cyclohexane, methanol, acetone and THF was first determined. In the second experiment, the coal was first swollen in cyclohexane and then dried. The same sample was then swollen in methanol. The sample was again dried and swollen in acetone. After drying, the sample was swollen in THF. The order of solvents chosen was that of increasing swelling ability. The swelling was the same for the raw coals and the coals previously swollen in the poorer solvent. The third experiment in-

volved reversing the order of solvent swelling, starting with THF. The coals showed increased swelling in the poorer solvents after swelling in the better solvent, even though the solvent was removed by drying between measurements. The THF therefore causes irreversible changes in the coal structure. Four additional coal samples have been separated by the maceral separation technique. The samples consist of the fractions collected at 15 seconds and at 1 minute in the flotation of two Utah coal samples. Relatively pure vitrinite fractions were collected and the material with lower and higher densities discarded. Measurements of surface areas (porosity) of coals treated by solvent swelling have continued. The measurements are conducted at -78°C with carbon dioxide as an absorbant. The surface areas are calculated by both the BET and Dubinin-Polanyi equations. Substantial differences are noted in the results, but the trends are the same for both calculations. 4 refs., 4 figs.

72 **(DOE/PC/81504—T1) Analogy application to nonuniform gas-solid flows. Quarterly report No. 1.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Sep 1985. Contract FG22-85PC81504. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002072.

This report describes the measurement of high pressure solid/gas flow with a Micro-Motion meter, analyzes the effects of system-parameters on Micro-Motion signals, establishes calibration curves and pressure-drop correlations for the Micro-Motion flowmeter. The study shows that this meter could be used in measuring solid/gas flows inside a 0.0095 m, diameter pipe at high pressures, especially at solid loadings greater than 10. When the solid loading (pound of coal/pound of gas) was less than or equal to 10, pressure-drop tends to indicate a phase separation and a probable change in flow regime within the Micro-Motion Meter, which could have occurred at the meter's U-bend. 5 refs., 11 figs., 1 tab.

73 **(IS-T—1223) PED: pressurized electroosmotic dewatering.** Heath, L.W. (Ames Lab., IA (USA)). Oct 1985. Contract W-7405-ENG-82. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86002108.

Mechanical solid/liquid separation or dewatering of fine-grained suspensions is difficult to accomplish with any degree of success, cost effectiveness and/or practicality. The use of electroosmosis, the electrokinetic transport of water, which is theoretically independent of pore size, on the other hand can be quite slow and consume a great deal of electrical energy. However, in combining pressure and electroosmosis, an effective dewatering process is realized because the strength of each dewatering process is the weakness in the other and the combination of the two processes has no ill effect on each other. The strength of electroosmosis is in its independence of pore size, whereas pressure removes the free water from the larger pores rapidly and causes consolidation to occur. The experimental program investigated the optimization of pressurized electroosmotic dewatering (PED) of ultra-fine coal suspensions. The slurry characteristics of greatest interest were the particle size distribution and zeta potential. The particle size distribution controls the maximum packing density and thus, the lowest pore volume, obtainable. A reduction in pore volume increases the degree of saturation for a given quantity of water. The zeta potential of a suspension directly governs the electroosmotic flow rate. A computerized data acquisition system was built to monitor the PED tests. This enhanced the research by allowing more test data to be obtained in a short time and more testing to be completed because of the reduced test analysis time. Also, other suspended materials such as kaolinite slurries, lignite slurries, phosphate slimes, red mud, fly ash scrubber slimes and diamond slimes were tested using PED. The test results provide a basis for pilot-scale testing of PED in a continuous manner. 15 refs.

74 **Field acquisition, processing, storing and monitoring of premium coal samples.** Dutcher, R.R.; Gunter, M.; Creeling, J.C. (Depart. of Geology and Coal Res. Center, Southern Illinois Univ.). pp 356-366 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Researchers in the coal sciences require premium samples for their work. The intent of this project was two-fold: a) develop techniques for collecting, processing, and storing coal samples to delay or stop sample alteration with time, and b) to develop and/or implement existing analytical tests to determine early alteration of coal samples. Four coals have been collected, processed and placed in four separate storage conditions. A series of tests designed to monitor these samples was initiated and results obtained on all storage conditions, for all coals on an approximately monthly basis. Next, all of the collected data was statistically processed to determine a) which of the measured physical and/or chemical properties had actually been observed to change as a function of storage environment and/or time, and b) if changes were present, in which environment were they minimized. Analysis of all the data - all coals - all storage conditions - seems to indicate that the main criteria for sample preservation is a function of temperature. The environment that best maintains the original condition is over liquid nitrogen.

0140 Combustion

REFER ALSO TO CITATION(S) 7, 9, 41, 44

75 **(DOE/ET/10393—1904-Vol.2) Test series 2.3 report. Volume II. Appendices.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Sep 1985. Contract AI01-76ET10393. 522p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85013707.

76 **(DOE/ET/10393—1905-Vol.2) Materials related activities during Test Series 2.2 and 2.3. Volume II. Appendices.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Sep 1985. Contract AI01-76ET10393. 608p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85013687.

These appendices include data on metal wastage of tubes, probes, heat exchangers, cyclone separators, etc. and final inspection and metallography results. (LTN)

77 **(DOE/FE/60181—140) Furnace injection of pressure hydrated lime.** Weber, G.F.; Bobman, M.H.; Dorchak, T.P. (North Dakota Univ., Grand Forks (USA). Energy Research Center; USDOE Grand Forks Project Office, ND). Oct 1985. Contract FC21-83FE60181. 6p. (CONF-851061—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001131.

From Clean coal technologies conference; Arlington, VA, USA (7 Oct 1985).

Pressure-hydrators are used to produce a highly reactive sorbent with a surface area and pore size distribution which enables maximum utilization of available calcium. The hydrator vessel is operated at pressures of 90 to 150 psig with temperatures up to 300°F. Upon expulsion of the reacted quicklime/saturated steam mix from the hydrator, water trapped inside the pore network of the hydrate particles is released explosively, yielding submicron-sized particles with a high specific surface area. The particles are flash-dried and collected for subsequent furnace injection tests. Initial tests at UNDERC were conducted to study the effect of injection-point temperature upon SO_2 removal. Optimal SO_2 removal occurred at about 1800°-1900°F (80%) with sorbent utilization of 40%. Progression from pilot to full-scale testing occurred in September 1984. PHLI was demonstrated at Otter Tail Power's Hoot Lake Station on a 50 MW tangentially-fired unit. Over 30 short-term tests were completed, plus one 30-hour duration of continuous injection. Fifty percent removal of SO_2 was observed with 25% sorbent utilization, and 70% removal of SO_2 occurred with sorbent utilization of 18.5%. Capture of SO_2 by the sorbent combined with inherent alkaline fly ash capture readily met compliance with the New Source Performance Standards. Compared to earlier results using limestone injection at Hoot Lake, the mass feed rate of PHL required to meet the minimum 70% removal of SO_2 decreased by a factor of 5. Emission levels were controlled at less than 10% opacity using the existing electrostatic precipitator, and boiler operation was not adversely impacted due to PHLI. An engineering and economic evaluation of PHLI has been prepared at UNDERC under DOE sponsorship.

78 **(DOE/MC/16518—T1-Vol.3) Prediction and measurement of entrained flow coal gasification processes. Volume III. Data Book: for evaluation of pulverized coal reaction models. Final report, 8 September 1983-28 February 1985.** Smoot, L.D.; Christensen, K.R. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 28 Feb 1985. Contract AC21-81MC16518. 176p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85017057.

A major task during this study has been the identification, collection and publication of detailed experimental data for evaluation of comprehensive coal gasification/combustion codes. A review of the literature was completed and prospective data were identified for inclusion in this data book in five categories of increasing complexity: (1) non-reacting, gaseous flows (58 cases); (2) non-reacting, particle-laden flows (43 cases); (3) gaseous combustion (34 cases); (4) pulverized coal combustion (57 cases); (5) entrained coal gasification (6 cases). Selection of these data was based on a set of criteria which included data completeness, availability of detailed, digital profiles for several properties (e.g., species concentrations, velocity, temperature) and data accuracy. From these 198 cases, which are referenced herein, the data base was reduced to a total of 37 sets of data from 8 laboratories, with at least 4 cases in each category above. For these 37 cases, the measured data, together with geometrical dimensions and test conditions were documented in a uniform tabular format in this report. These data were also stored on a mganetic tape for distribution. Possible experimental errors and limitations in the data base were identified and recommendations were made for additional experimental studies. Computations with the generalized coal gasification code (PCGC-2, see Volume 2, User's Manual) developed as a part of this and other contracts have been completed for all 37 of these sets of data. Some of the comparisons of predictions and measurements are summarized in Volume 1 of this final report and also in Volume 1 of the interim report (January 1984) for this same contract. 71 refs., 8 figs.

79 **(DOE/PC/81510—T2) Operation and maintenance of DOE/PETC Combustion Test Facilities. Final activity report, January 1, 1985-May 17, 1985.** (Management and Technical Services Co., Philadelphia, PA (USA)). 1985. Contract AC22-85PC81510. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85017230.

The work in the Combustion Test Facilities is divided into three main programs, Alternate Fuels/In-House Research, Flue Gas Cleanup Research and Development, and Advanced Research and Technology Development. The bulk of the work in this contract was concluded on May 17, 1985. The work on several programs is described in some detail.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 5, 108, 785

80 **(DOE/EIA—0121(85/2Q)) Quarterly Coal Report, April-June 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 18 Oct 1985. 104p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE86001827.

The Quarterly Coal Report provides comprehensive information about coal production, exports, imports, receipts, consumption, and stocks in the United States. The data presented in this report were collected and published by the Energy Information Administration (EIA) to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (P.L. 93-275) as amended. This issue shows detailed quarterly data for April-June 1985, aggregated quarterly historical and projected data for 1980 through 1986, and aggregated annual historical and projected data for 1960 through 1995. All data for 1984 and previous years are final. All 1985 data are preliminary and subject to revision. During the first and second quarters of 1985, the US coal industry continued to return to normal operations after the threat of a strike by US coal miners in 1984. For the first 6 months of 1985 the industry showed the following developments: Coal production was only 2.4% less than in the same period of 1984, when it reached a record January-June total. Coal exports were 10.0% higher than their 1984 level for the same time period. The United States imported 52.3% more coal than it did in the first 6 months of 1984, chiefly from Colombia. Domestic coal consumption reached a record-setting level for January-June, 3.6% greater than the previous record in 1984.

81 **(DOE/RA/50013—T1) Southeastern Michigan coal-oil-mixtures market aggregation project. Part I. Final report.** (Michigan Energy and Resource Research Association, Detroit (USA)). 30 Nov 1981. Contract FG01-80RA50013. 15p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85017602.

Coal-oil mixtures (COM) has the potential to be a quick, economical, and logical step in the nation's move to coal as the primary energy source. To help stimulate the use of COM in Southeastern Michigan, the Michigan Energy and Resource Research Association (MERRA) organized a special team representing Michigan industry, utility, university, and government sectors with the goal of making COM available in the region and obtaining use agreements from consumers currently relying on oil or natural gas. Specific intentions of the project were to identify potential COM users, remove obstacles that might slow development, and allow the market to go to work.

0160 Health And Safety

REFER ALSO TO CITATION(S) 66

82 **(DOE/EV/10726—T1) Environmental control implications of lignite utilization. Final report.** McFarland, A.R.; Fisher, G.L.; McNeill, K.L.; Prentice, B.A.; Ortiz, C.A. (Texas A and M Univ., College Station (USA). Air Quality Lab.). Aug 1985. Contract AS05-81EV10726. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001599.

A 600 kg sample of fly ash was collected from the hoppers of a lignite fired power plant. The sample was size-classified into three fractions: fine, medium, and coarse, with volume median aerodynamic diameters of 2.8, 6.6, and 30.0 μm, respectively. Physical, chemical, and biological analyses were performed on the samples. Morphologically, the lignite fly ash samples are quite similar to coal fly ash. Neutron activation analysis showed the levels of arsenic to be comparable to the levels detected in coal fly ash. The arsenic concentration in unfractionated lignite fly ash is 34 μg/g and that in the Fine Fraction was 310μg/g as compared with 19 μg/g in a coarse sample and 198 μg/g in a fine sample of coal fly ash. For selenium, the unfractionated lignite contained 12 μg/g and the fine fraction, 23 μg/g. The concentration of uranium in the unfractionated sample was 12 μg/g and that in the Fine was 29 μg/g. The lignite fly ash showed neither mutagenicity in the Ames test, nor did it affect the viability of pulmonary alveolar macrophage (PAM). On the other hand, the phagocytic activity of PAM is somewhat depressed by exposure to the fine and medium fraction of lignite fly ash. 14 refs., 4 figs., 7 tabs.

83 **(PB—85-220721/XAB) Precision of coal mine dust sampling.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1984. 71p. NTIS, PC A04/MF A01.

The precision of coal-mine dust sampling was evaluated. Data was obtained from all relevant literature and unpublished studies conducted by the Mine Safety and Health Administration (MSHA), NIOSH, and the Bureau of Mines. Coefficients of variation were determined. Coefficients of variation as a function of error source were analyzed using data obtained by routine field sampling by the Dust Division of MSHA. The contribution of weighing errors to the coefficient of variation increased as sample size decreased. The authors conclude that coal-mine dust-concentration measurements made in the field by trained personnel have a precision of approximately 20%. Most of the inaccuracy results from random errors in sampling.

84 **(PB—85-221026/XAB) National Coal Study and related research. Final report from Round Three of the study.** Attfield, M. (National Inst. for Occupational Safety and Health, Morgantown, WV (USA)). 1984. 220p. NTIS, PC A10/MF A01.

Results of the National Coal Study are presented. Thirty-two coal mines were visited and 5275 miners were examined during a 5-year period. The incidence and progression of coalworkers pneumoconiosis was studied. Longitudinal declines in 1 second forced expiratory volume (FEV1) in coal miners were investigated. The author suggests that the degree and progression of pneumoconiosis was reduced by applying the 2mg/m^3 dust standard.

85 **Occupational health study at the KRW coal gasification PDU.** Evans, J.M.; Simonson, A.V.; Vandergrift, E.F. (Gas Research Inst.). pp 415-425 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The occupational safety and health data developed during the 1983 industrial hygiene surveys at the KRW PDU show that, except for the presence of dust, carbon monoxide and potentially, hydrogen sulfide, all emitted under non-routine conditions, all potential contaminents were either not detected, or were present at concentrations well below permissible exposure limits. These data were consistent with monitoring results reported in the two previous studies. These data, together with the data developed from the PDU records, indicate that the potential for adverse occupational safety or health effects with respect to the KRW coal gasification process is no worse than that of any industrial process when coal, carbon monoxidee or hydrogen sulfide are handled on a routine basis. The occupational safety and health data show minimal potential for exposure to PAH-containing materials. Personal monitoring for exposure to airborne PAH's, screening of workplace surfaces, and examination of workclothing for evidence of PAH-contamination all showed minimal cause for concern. In contrast to some coal gasification processes where extensive measures are needed for control of tar-related exposures, the need for such controls for the KRW process appears minimal. These observations are preliminary and should be verified once a larger scale KRW facility is in operation.

02 PETROLEUM

0201 Reserves

86 **(DOE/EIA—0216(84)) US crude oil, natural gas, and natural gas liquids reserves. 1984 annual report.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Sep 1985. 89p. NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. File Number DE86000658.

This report presents estimates of proved reserves of crude oil, natural gas, and natural gas liquids as of December 31, 1984, for the total United States and for selected state and state subdivisions as well as production volumes for the year 1984. Aggregated data are presented on crude oil proved reserves in nonproducing reservoirs and on the commitment status of natural gas proved reserves in both producing and nonproducing reservoirs. These estimates are based upon data obtained from two annual EIA surveys: Form EIA-23, Annual Survey of Domestic Oil and Gas Reserves; and Form EIA-64A, Annual Report of the Origin of Natural Gas Liquids Production. Data are also presented on notable oil and gas exploration and development activities during 1984. A glossary of the terms used in this report and in survey Forms EIA-23 and EIA-64A is provided to assist readers in more fully understanding the data presented in this publication. 9 figs., 17 tabs.

87 **(DOE/EIA—0467) Petroleum resources of South America: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, and Peru. Foreign Energy Supply Assessment Program series.** Dietzman, W.D.; Rafidi, N.R. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Jan 1983. 312p. NTIS, PC A14/MF A01; 1 - GPO; GPO Dep. File Number DE86002042.

This report is an analysis of discovered crude oil reserves, undiscovered recoverable crude oil resources, and estimated annual oil field production. The countries analyzed are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, and Peru. All of the countries in this report have a history of petroleum exploration and development. Also, they maintain policies which support the search for, and exploitation of, petroleum resources. This systematic assessment provides estimates of the quantities of remaining known petroleum reserves and undiscovered recoverable resources. The future feasible production rates from the respective countries are also discussed. The FESAP assessments are limited to petroleum resources recoverable by conventional primary and secondary extraction technology. It is estimated that over 29.4 billion barrels of recoverable oil (both discovered and undiscovered) originally existed within the sedimentary basins of these countries, as follows: Argentina (9.4 billion barrels); Brazil (6.5 billion barrels); Colombia (5.0 billion barrels); Peru (3.6 billion barrels); Ecuador (over 3.0 billion barrels); Chile (1.1 billion barrels); and Bolivia (over 0.8 billion barrels). Through 1982, about 10.2 billion barrels of the oil had been produced. Thus, some 19.2 billion barrels constitute the remaining recoverable petroleum resource base. It is estimated that the most likely volume of crude oil remaining to be found in the seven countries is 12 billion barrels. 91 refs., 59 figs., 82 tabs.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 120

88 **(PB—85-217669/XAB) Reproduction and distribution of fishes in a cooling lake: Wisconsin power plant impact study.** Rondorf, D.W.; Kitchell, J.F. (Wisconsin Univ., Madison (USA). Water Resources Center). Jun 1985. 69p. NTIS, PC A04/MF A01.

Spatial and temporal patterns during reproduction and early-life history of fishes were studied in a manmade cooling lake. Lake Columbia, impounded in 1974, near Portage, Wisconsin, has an area of 190 ha, a mean depth of 2.1 m, and a 15C temperature gradient derived from the thermal effluent of a 527-MW fossil-fueled generating station that began operating in 1975. The lake was initially colonized by fishes when filled with Wisconsin River water. Observations suggest a decline of species diversity of the fish community due to direct action of upper lethal temperatures, absence of colonization by warm-water, lake-dwelling species, and lack of recruitment for certain species. Spatial and temporal patterns of spawning of black crappie were altered by a rapid rise in water temperatures following plant startup after a three-week shutdown. Elevated temperatures subsequently shortened the spawning season, induced resorption of ova, and caused loss of secondary sexual characteristics. After initially drifting with water current, juvenile stages of sunfish and gizzard shad responded to changes in the thermal gradient by horizontal and vertical shifts in abundance.

89 **Interrelationships between in-situ gas hydrates and heavy oil occurrences on the North Slope of Alaska.** Collett, T.S. (U.S. Geological Survey). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* SPE13594: 45-50(Mar 1985). (CONF-830512—).

From IEE/APS symposium; Houston, TX, USA (23 May 1983).

In 1973 during the drilling of the West Sak #1 well on the North Slope of Alaska, oil was first recovered from a shallow Cretaceous sand interval which was later informally named the West Sak sands by ARCO Alaska. Stratigraphically above the West Sak sands there are two additional oil bearing sands, and are informally referred to by ARCO as the Ugnu and the 2150 horizons. Oils in these shallow sands appear to have migrated from the nearby, more deeply buried Prudhoe Bay Sadlerochit reservoir and appear to have lost substantial amounts of light hydrocarbons as the deeper oil passed through the bubble point at approximately 1,219 m (4,000 ft) during updip migration, reducing the API gravity. In addition the shallow oil appears to have suffered biodegradation further lowering the API gravity. The updip portion of these three reservoir sands are within the gas hydrate stability field. Gas hydrates are interpreted to exist in the West Sak #6 well in conjunction with

heavy oil and the physical properties of this oil may have been influenced by the gas hydrate. Prior to this work, only experimental evidence suggested that hydrates and oil could exist in the same reservoir.

0203 Drilling And Production

90 **(DOE/BC/10811—1) Isolation and screening of anaerobic Clostridia for characteristics useful in enhanced oil recovery. Final report, October 1983-February 1985.** Grula, M.M.; Russell, H.H. (Oklahoma State Univ., Stillwater (USA). Dept. of Botany and Microbiology). Oct 1985. Contract AS19-83BC10811. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000144.

Strains of Clostridium isolated and screened for properties thought to be useful in enhanced oil recovery have been tested for their reactions to high sodium chloride concentrations, with the ultimate goal of developing more salt-resistant strains. Gas and solvent production by certain high gas-producing strains has been tested in the presence of various pulverized cores. The minerals in these cores can enhance and prolong gas production, enhance or delay spore germination or growth and metabolism of the bacteria in situ. The presence of a source of nitrogen and of energy are essential for continued gas production. A sampling of viable bacteria present in connate water, holding tanks, and other sites near oil fields showed a majority to be Gram positive, aerobic strains. For downwell work with Clostridium, beet molasses is a generally good and economical source of energy. Tests of connate water for toxicity for strain to be used, in the medium to be used, are essential. We have achieved downwell fermentations, as shown by CO_2 and solvent production, and in one case a significantly increased oil production. 10 refs., 9 figs., 23 tabs.

91 **(NIPER—85) FY86 Annual research plan, National Institute for Petroleum and Energy Research.** (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1985. Contract FC19-83FE60149. 191p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85000143.

NIPER's program of research encompasses three different thrusts. The DOE funds a five-million-dollar Base Program designed to undertake long-range, high-risk research on petroleum and similar materials that companies are generally unwilling to do. A second five-million-dollar program, the Optional Program, cost-shares research on petroleum and substitute fossil fuels between DOE and contributing participants. For FY86, the DOE share will be two million dollars and three million dollars will be contributed by other government agencies and industrial participants. The third program is a Work for Others Program which allows NIPER to solicit work from the private sector and others. This Annual Research Plan only covers the Base and Optional Programs. NIPER is organized into two research departments - Energy Production Research (EPR) and Fuels Research (FR). Projects in EPR deal with various aspects of enhanced oil recovery and include chemical flooding, gas injection processes, steam injection, and microbial enhanced oil recovery. Projects in FR are concerned with the impact of heavy oil and alternate fuels on processing and use of fuels. This breadth of interest assures that NIPER's work will be significant in advancing petroleum technology and that NIPER will be a viable place for research by other government agencies and industrial clients. For Fiscal Year 1986, the Base Program will have 14 projects and the Optional Program will have 16. EPR has nine projects in the Base Program and six in the Optional Program while FR has five in the Base Program and ten in the Optional Program. These projects are described.

92 **Pressure transient analysis methods for bounded naturally fractured reservoirs.** Chen, C-C; Raghavan, R.; Reynolds, A.C.; Serra, K. (Univ. of Tulsa). *SPEJ, Society of Petroleum Engineers Journal;* **25**: No. 3, 451-462(Jun 1985).

New methods for analyzing drawdown and buildup pressure data obtained at a well located in an infinite, naturally fractured reservoir were presented recently. In this work, the analysis of both drawdown and buildup data in a bounded, naturally fractured reservoir is considered. For the bounded case, the authors show that five possible flow regimes may be exhibited by drawdown data. They delineate the conditions under which each of these five flow regimes exists and the information that can be obtained from each possible combination of flow regimes. Conditions under which semilog methods can be used to analyze buildup data are discussed for the bounded fractured reservoir case. New Matthews-Brons-Hazebroek (MBH) functions for computing the average reservoir pressure from buildup data are presented.

93 **The Fenske conservation method for pressure transient solutions with storage.** Horne, R.N. (Stanford Univ.). *SPEJ, Society of Petroleum Engineers Journal;* **25**: No. 3, 437-444(Jun 1985).

A method for determining pressure transient solutions for wells with storage (and skin) is presented; this method is based on an approach developed by Fenske in the groundwater literature. By specifically conserving the entire mass of the system, including the wellbore or wellbores, it is possible to generate many common type curves. The procedure can be developed in an exact manner, in which case it is equivalent to existing techniques; however, a simple approximation step makes possible the generation of common solutions without recourse to numerical or ornate analytical techniques. In some cases, the approximation provides equivalent solutions with substantially less computation; in other cases, the solutions are significantly in error, although perhaps still usable. The achievement of computationally rapid, closedform solutions is of significant advantage for current developments in computerized interpretation. The evaluation of a solution can be hastened by three orders of magnitude over conventional methods in some cases. Examples given in this paper demonstrate the application of the approximate Fenske method and its exact generalization. The Fenske method is applicable to a wide variety of problems with storage and skin, probably including problems as yet unsolved. An approximate form is available for fast calculation, and the more correct form is equivalent to standard analytical methods.

94 **Thermodynamic modeling of quaternary systems: oil/brine/surfactant/alcohol.** Kilpatrick, P.K.; Davis, H.T.; Scriven, L.E. (Univ. of Minnesota). *SPEJ, Society of Petroleum Engineers Journal;* **25**: No. 3, 330-342(Jun 1985).

Surfactant flooding for EOR results in multiphase oil/brine/surfactant/alcohol mixtures. Because alcohol and surfactant do not partition among the phases in constant proportion, thermodynamic modeling of quaternary systems is necessary in an accurate treatment of phase equilibria in these systems. We describe here the quaternary version of a free-energy-based equation of state (EOS). The systematic computation of phase equilibria in a quaternary system begins on the binary edges and ternary faces and proceeds by numerical continuation through the higher dimensional composition space. We expedite the computation with knowledge of the limits of thermodynamic stability--the spinodal surfaces--and all critical points that lie on those surfaces. This preliminary calculation indicates those regions in which solution of the nonlinear equations of phase equilibria will suffer from slow numerical convergence. Multiphase equilibria are searched out by both parametric and compositional continuation. The results provide the basis for understanding the trends of three- and four-phase equilibria in oil/brine/surfactant/alcohol mixtures.

95 **Adsorption/desorption of sulfonates by reservoir rock minerals in solutions of varying sulfonate concentrations.** Pomasundaran, P.; Hanna, H.S. (Columbia Univ.). *SPEJ, Society of Petroleum Engineers Journal;* **25**: No. 3, 343-350(Jun 1985).

In micellar flooding, reservoir rocks are exposed to surfactant solutions of varying concentrations as the surfactant slug advances through the reservoir. Therefore, the attachment and detachment of sulfonates with rocks that are already exposed to surfactant solutions of higher or lower concentrations is of major interest. In this study, the abstraction behavior of purified Na-dodecylbenzenesulfonate on Na-kaolinite by stepwise increase in surfactant concentration is determined. Deabstraction* occurring after reductions in surfactant concentrations at various stages also is determined. Most importantly, the results of incremental abstraction, individual abstraction, and deabstraction showed the system to exhibit hysteresis or memory effects. Also, abstractions obtained at various pH values and during stepwise changes in pH exhibited marked

differences. The deabstraction isotherms showed the presence of maximum in certain cases, indicating the occurrence of maximum on the abstraction isotherms to be a real phenomenon. Possible reasons for the hysteresis are considered, and the practical implications of these memory effects on micellar flooding and depletion experiments using cores are discussed.

96 **Ethoxylated oleyl sulfonates as model compounds for enhanced oil recovery.** Carmona, I.; Schechter, R.S.; Wade, W.H.; Weerasooriya, U. (Univ. of Texas). *SPEJ, Society of Petroleum Engineers Journal;* **25**: No. 3, 351-357(Jun 1985).

Precisely ethoxylated oleyl sulfonates were prepared and studied as model surfactant candidates for EOR. They were found to yield low interfacial tensions (IFT's), to give high solubilization parameters, and to have high electrolyte tolerance. Unfortunately, as a class of compounds they have a tendency to form liquid crystals (rather than microemulsions), which must be overcome by adding cosolvents, elevating temperatures, or restricting the maximally ethoxylated species.

97 **Green's functions for solving unsteady flow problems in naturally fractured reservoirs with arbitrary fracture connectivity: part i-theory.** Wiejesinghe, A.M. (Lawrence Livermore National Laboratory). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13626**: 363-386(Mar 1985). (CONF-830512—).

From IEE/APS symposium; Houston, TX, USA (23 May 1983).

A general theory of Green's functions for solving boundary-initial value problems governed by two linear pressure diffusion equations coupled through a fluid transfer term which depends on the pressure histories, is presented. The governing equations, developed previously by Wijesinghe and Culham (1984), describe the flow of fluid in naturally fractured reservoirs with arbitrary fracture connectivity simultaneously taking into account both fracture and pore system permeabilities and unsteady interporosity fluid transfer. In this study, the relationship between the Green's functions (ie. generalized source solutions) and the adjoint Green's functions is determined, and the boundary conditions which must be imposed on the adjoint Green's functions to obtain explicit solutions for the fracture and pore pressures, are presented. The fundamental Green's functions, which characterize the basic properties of the two coupled differential equations, are derived and examples of their application to reservoir fluid flow problems are given. As in the case of the classical diffusion equation for fluid flow in single porosity formations, the Green's functions based on the present theory enable solutions to complex fluid flow problems in naturally fractured reservoirs to be systematically constructed from simpler source solutions.

98 **The effect of annulus water on the wellbore heat loss from a steam injection well with insulated tubing.** Aeschliman, D.P. (Sandia National Laboratories). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13656**: 631-644(Mar 1985). (CONF-830512—).

From IEE/APS symposium; Houston, TX, USA (23 May 1983).

Recently completed field experiments using an instrumented string and test well have verified that the presence of annulus water in injection well annuli introduces a real and economically important heat loss mechanism, wellbore refluxing, for surface-generated steam. Measured boiling heat transfer rates at local hot spots are sufficient to maintain steady refluxing over a realistic range of injection conditions and overburden properties. It is shown that with the wellbore wet, the thermal properties of the cement and overburden, not those of the insulated tubulars, control the magnitude of the wellbore heat loss.

99 **Dynamics of subcritical CO_2/brine floods for heavy oil recovery.** Rojas, G.; Faroug, S.M. (U. of Oriente). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13598**: 81-94(Mar 1985). (CONF-830512—).

From IEE/APS symposium; Houston, TX, USA (23 May 1983).

Immiscible carbon dioxide flooding is an important, field-proven heavy oil recovery method, particularly suited for thin, marginal, or otherwise poor heavy oil reservoirs, where thermal recovery processes are likely to be uneconomical. This paper describes dynamics of this recovery technique, based upon experiments conducted in a scaled model. The experiments represent a medium heavy oil (1032 mPa.s at 23° C) occurring in a shallow, thin sand. Carbon dioxide was injected at subcritical conditions (5.5 MPa, 21-23° C), together with brine. The scaled experiment results showed that oil recoveries at CO_2 and brine breakthroughs were ratedependent. While recovery at CO_2 breakthrough decreased with increasing rate, recovery at brine breakthrough increased. Reduction of interfacial tension between brine and oil, leading to the formation of brine-in-oil emulsions, was found to be an additional effective mechanism of heavy oil recovery by CO_2/brine injection.

100 **Well site drill stem test analysis.** Anderson, T.O. (Halliburton Services). pp 187-197 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Drill stem tests have been used for many years to evaluate the production potential of oil and gas reservoirs. Data obtained from such tests are applied many times to make a judgment of the economic potential of completing a well or a field. Until recently mechanical pressure and temperature recording devices have been used to record the sub-surface parameters. Interpretation of this recorded data was not possible until the testing string and recording instruments were retrieved from the well. Computer based systems for recording and analyzing the sub-surface data as the test progresses have been recently introduced. The instrumentation system combined with full opening drill stem testing strings which provide the flow capacity necessary for a more complete reservoir evaluation has enabled operators to efficiently conduct the tests and obtain the most meaningful data for an evaluation by the well operator of the reservoir being tested.

101 **Tailored pulse loading in multiple fracture stimulation.** Hanson, J.M.; Schmidt, R.A.; Cooley, C.H.; Schatz, J.F. (Terra Tek, Inc.). pp 176-186 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Many hydrocarbon-bearing reservoirs are insufficiently permeable to allow for economic exploitation by conventional well completion techniques. Tailored pulse loading, usually by downhole use of propellants or explosives, has been studied as a means of improving production in these reservoirs. This paper presents an overview of the first year's effort on a three-year combined theoretical-experimental research program aimed at developing a systematic understanding of the tailored pulse loading/fracturing phenomena. The project is designed to address the sensitivity of multiple fracture initiation and propagation to rock and fluid properties and pressurization history.

102 **A modified hydraulic fracturing technique using optimized perforation placement location.** Ahmed, U.; Thompson, T.W.; Kelkar, S.M.; Strawn, J.; Veghte, R. (Terra Tek, Inc.). pp 147-165 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The success of a hydraulic fracture treatment is greatly enhanced by control of the created fracture geometry. This problem is most serious if the boundary lithologies are not highly stressed as compared to the pay zone and do not form an effective barrier to upward migration. The Perforation Placement Optimization technique involves the determination of perforation locations such that the hydraulic fracture contact area within the pay zone is optimized thereby allowing increased hydrocarbon production. This paper discusses the development, application, and evaluation of the modi-

fied hydraulic fracturing technique. This particular technique has been developed as part of a research program sponsored by the Gas Research Institute of Chicago and conducted by Terra Tek, Inc. of Salt Lake City and Chandler and Associates of Denver.

103 **Prospects for EOR in the US.** Johnson, H.R. *Well Serv.;* **20**: No. 1, 51-56(Jan-Feb 1982).

The demand and rising value of petroleum have sparked renewed efforts to improve oil recovery techniques and to discover new ways to recover oil from reluctant reservoirs. The vast quantity of unrecovered petroleum in oil fields is estimated to exceed 300 billion bbl and is a tempting target. Improvements in recovery technology are evolutionary, and techniques that work well in the laboratory must be fully tested in field application. This study reviews the potential for enhanced oil recovery (EOR), the evolutionary nature of the recovery processes being applied in oil fields today, key parameters that describe the technology state of the art for each of the major oil recovery processes, and the nature and key outputs from the current U.S. Department of Energy (DOE) research program on EOR. The DOE program is focused on the analysis of ongoing test and on long-range, basic research to support a more thorough understanding of process performance. Data from the program will be made available through reports, symposia, and on-line computer access. The outputs are designed to allow an independent producer to evaluate his own project as an effort to transfer rapidly the technology now being developed. 10 references.

0204 Processing

REFER ALSO TO CITATION(S) 91

104 **(DOE/PE/72013—1) Gasoline octane enhancement: technology, economics, and environmental, health and safety considerations.** (Mueller Associates, Inc., Baltimore, MD (USA)). Jul 1985. Contract AC01-84PE72013. 104p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85014694.

Purpose of this report is to provide an understanding of the many facets of octane enhancement of gasoline as they relate to environmental, health and safety matters. The use of non-lead octane enhancers will accelerate as lead is phased down and the mix of fuel grades shifts toward more unleaded fuels. The focus of this document is, accordingly, placed on the non-lead alternatives for improving octane. Future patterns of use of these non-lead compounds are not clearly understood. Gasoline refiners and blenders have many options for improving the octane levels of their products and it is not possible to predict now which options, if any, will predominate given the complex economics involved and a changing regulatory environment. Because of the uncertainty, this report includes extensive reviews of the technology, economics, and regulatory aspects of octane enhancement to provide the reviewer with the framework within which future octane enhancement decisions will be made. Minimal attention is given to lead antiknocks.

0205 Products And By-products

REFER ALSO TO CITATION(S) 394, 853

105 **(PB—85-225688) Determination of nitro-polynuclear aromatic hydrocarbons in diesel soot by liquid chromatography with fluorescence and electrochemical detection.** MacCrehan, W.A.; May, W.E. (Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI (USA)). 1985. 12p. NTIS.

Two new detection approaches for the HPLC determination of nitro-polynuclear aromatic hydrocarbons (N-PAH) are described. The molecular fluorescence method is based on the reduction of the nitro group to the fluorescent amine using a post-column zinc reductor. Wavelength programming is used to improve the selectivity and sensitivity of the detection of N-PAH. The electrochemical detection method uses the reduction current of the nitro group for measurement of the N-PAH. A differential pulse waveform is used to enhance the selectivity of the detector. Sample preparation methods for N-PAH in diesel soot are described.

0206 Health And Safety

106 **(PB—85-208320/XAB) Health hazard evaluation report HETA 83-248-1515, Arco Philadelphia refinery, Philadelphia, Pennsylvania.** Lewis, F.A.; Parrish, G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1984. 13p. (HETA—83-248-1515). NTIS, PC A02/MF A01.

A bulk sample of fractionator residue was analyzed for polynuclear aromatic (PNA) compounds at the catalytic cracking unit of ARCO Philadelphia Refinery (SIC-2911), Philadelphia, Pennsylvania in May, 1983. The study was requested by the Atlantic Independent Union to determine if skin rashes and skin irritation occurring among refinery workers were caused by PNA in the fractionators. The authors conclude that a health hazard from exposure to chemicals at the cracking unit may exist. No specific chemical agent can be identified. Dust from the catalyst and oily residues that could contaminate workers shoes and clothing may have contributed to some of the dermatitis cases. Recommendations include laundering workers coveralls by dry cleaning to insure the removal of oily residues, providing workers with oil resistant or oil proof work boots, and repairing the ventilator in the sample preparation room adjacent to the block house.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 785

107 **(DOE/EIA—0109(85/08)) Petroleum Supply Monthly, August 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 23 Oct 1985. 111p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE86002082.

US supply, disposition and stocks of crude oil and petroleum products are reported for each year from 1973 through 1985, with monthly data given for the most recent 3 years. Detailed statistics are given for the most recent month available. Shown are: supply and disposition for the US and each Petroleum Administration for Defense (PAD) District; production of crude oil and lease condensate by State and PAD District; natural gas processing plant production by PAD District; refinery operations by PAD District; imports and exports of crude oil and petroleum products; stocks of crude oil and products by PAD District; transportation between PAD Districts; and heavy fuel oils by sulfur content. A glossary, maps of various Districts, and explanatory notes discussing the data collection methodology are included. This issue contains articles entitled 'World Oil Price and Inventory Cycles' and 'Petroleum Storage Technologies'. 13 figs., 33 tabs.

108 **(DOE/EIA—0219(84)) International Energy Annual 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 16 Oct 1985. 116p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE86001829.

This report presents current data and trends for production, consumption, stocks, imports and exports for primary energy supplies in more than 190 countries, dependencies and areas of special sovereignty. Also included are prices on petroleum, petroleum products in selected countries. Data are provided for: total primary energy production; crude oil and natural gas liquids production; petroleum consumption, trade and stocks; natural gas production, consumption, and trade; coal production, consumption, and trade; hydroelectric power production; nuclear electric power production; and oil, natural gas and coal reserves. 21 figs., 34 tabs.

109 **(GAO/RCED—85-80) Evaluation of the Department of Energy's plan to sell oil from the Strategic Petroleum Reserve.** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 5 Jun 1985. 73p. US General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86900084.

Report to The Chairman, Subcommittee on Fossil and Synthetic Fuels, Committee on Energy and Commerce, House of Representatives.

The administration plans to reduce the effects of a severe oil supply disruption by selling oil from the Strategic Petroleum Reserve (SPR). Under a Department of Energy (DOE) plan, the oil would be sold at periodic auctions, with sales contracts awarded to the highest bidders. All interested parties who agree to DOE's contract terms and conditions would be eligible to bid. GAO's evaluation of DOE's plan addressed (1) its potential effects on world oil prices, (2) issues affecting who would get SPR oil under this plan, and (3) how the plan compares with alternative sales mechanisms. GAO found that the plan's market approach would, as intended, probably limit oil price increases in a severe supply disruption and would allow broad participation in the sale. Nevertheless, GAO identified some potential problems relating to buyer participation under the plan. 1 fig.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 1462, 1465

110 **(EGG—10282-2080) Results of preconstruction surveys used as a management technique for conserving endangered species and their habitats on Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California.** Kato, T.T.; O'Farrell, T.P.; Johnson, J.W. (EG and G, Inc., Goleta, CA (USA). Santa Barbara Operations). Aug 1985. Contract AC08-83NV10282. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86002064.

In 1976 an intensive program of petroleum production at maximum efficient rate was initiated on the US Department of Energy's (DOE) Naval Petroleum Reserve No. 1 (Elk Hills) in western Kern County, California. In a Biological Opinion required by the Endangered Species Act, the US Fish and Wildlife Service concluded that proposed construction and production activities may jeopardize the continued existence of the endangered San Joaquin kit fox, Vulpes macrotis mutica, and the blunt-nosed leopard lizard, Gambelia silus, inhabiting the Reserve. DOE committed itself to carrying out a compensation/mitigation plan to offset impacts of program activities on endangered species and their habitats. One compensation/mitigation strategy was to develop and implement preconstruction surveys to assess potential conflicts between proposed construction activities, and endangered species and their critical habitats, and to propose reasonable and prudent alternatives to avoid conflicts. Between 1980 and 1984, preconstruction surveys were completed for 296 of a total of 387 major construction projects encompassing 3590 acres. Fewer than 22% of the projects potentially conflicted with conservation of endangered species, and most conflicts were easily resolved by identifying sensitive areas that required protection. Only 8% of the projects received minor modification in their design or locations to satisfy conservation needs, and only three projects had to be completely relocated. No projects were cancelled or delayed because of conflicts with endangered species, and costs to conduct preconstruction surveys were minimal. 27 refs., 9 figs., 2 tabs.

111 **Laboratory evaluation of chemical dispersants for use on oil spills at sea.** Anderson, J.W.; McQuerry, D.L.; Kiesser, S.L. (Battelle, Marine Research Lab., Sequim, WA). *Environmental Science and Technology;* **19**: No. 5, 454-457(1985). Contract AC06-76RL01830.

Data on toxicity and effectiveness of 14 chemical dispersants were combined in a straightforward equation to provide an overall assessment of the relative merits of the oil spill chemicals. When a decision is made by regional response authorities to mitigate the damage of spilled oil to the shoreline, these findings should aid in the selection of an effective low toxicity product. Products were evaluated by using standard toxicity tests with a mysid shrimp (Mysidopsis bahia) and a standard effectiveness test using the Mackay-Nadeau-Steelman (MNS) apparatus. Ratios of dispersant to oil required to maintain 90% dispersions of oil in seawater (15°C and 30%) with a standard mixing energy (1.0 in. of water pressure) of air flow were derived for each chemical by using Prudhoe Bay crude oil. Toxicity tests with M. bahia were conducted at 25°C and 2.5% by using freshly hatched juveniles (15 per concentration times 5 concentrations) in small dishes in an incubator.

112 **Field-based computational techniques for predicting subsidence due to fluid withdrawal.** Helm, D.C. (Lawrence Livermore National Lab., CA). *Geological Society of America Reviews in Engineering Geology;* **6**: 1-22(1984). Contract W-7405-ENG-48.

If only the depth and thickness of compressible beds can be estimated, a simple hand calculation is available as a predictive technique and for many purposes is adequate. An example of such a technique uses Schatz, Kasameyer, and Cheney's depth-porosity model. Their depth-porosity model for reservoir compaction is modified in the present paper and is combined with a modified form of Geertsma's nucleus of strain model to form a single predictive technique. The nucleus of strain model accounts for attenuation of vertical movement through the overburden. Based on this combined model, prediction of ultimate vertical subsidence are made at eleven specified locations. At five of these sites in California, Texas, and New Zealand, these predictions are compared to measured subsidence. Agreement between predicted and observed subsidence is good. If field measurements of water-level fluctuations and the resulting time-dependent compression and expansion of geologic strata are locally available, use of a more refined predictive technique is justified. Tolman and Poland's conceptual model and Riley's parameter evaluation method have been combined with Helm's one-dimensional finite difference computational scheme to form a powerful time-dependent predictive technique. This technique has been field verified successfully at more than two dozen sites in California and Texas. Use of such a computer code allows prediction of observed time lags in nonlinear compression and expansion of layered sedimentary materials in response to arbitrary sequences of rising and falling water levels. 79 references, 22 figures, 4 tables.

0210 Legislation And Regulation

113 **(DOE/NBM—6001545) Study of the effect on selected oil and gas companies of "The President's tax proposal to the Congress for fairness, growth and simplicity".** (Touche Ross and Co., Washington, DC (USA)). 31 Jul 1985. 47p. NTIS, PC A03/MF A01 - GPO; GPO Dep. File Number DE86001545.

The overall objective of the Touche Ross study was to determine, on a hypothetical basis under a given set of assumptions, the effect on corporate federal income tax liability of selected changes included in the President's proposal. In addition to two "Test" companies whose data were used to develop most of the methodologies, assumptions and general approach, nine oil and gas companies participated in the study, with the understanding that their data remain confidential and that their individual company could not be identified in the study results. For the study companies three conclusions can be drawn: (1) Over the study period, the cumulative effect of the President's proposal, on companies with significant taxable income, is generally to reduce taxes approximately 25%. This is due primarily to the corporate tax rate reduction. (2) The proposed alternative minimum tax results in higher taxes and will affect more of the companies than the minimum tax included in current law. (3) Most of the companies that pay no tax under current law will pay no tax under the President's proposal.

0220 Transport, Pipelines, And Handling

114 **Geothermal design of insulated foundations for thaw prevention.** Nixon, J.F. (Hardy Associates (1978) Ltd., Calgary, Alberta, T2E 6J5). pp 924-927 of Permafrost, Fourth International Conference Proceedings. Washington, DC; National Academy Press (1983). (CONF-830703—).

From 4. international conference on permafrost; Fairbanks, AK, USA (18 Jul 1983).

As development in the North American Arctic proceeds to more northerly remote regions, the demand for reliable and thermally acceptable foundations for heated structures on permafrost will increase. In subarctic areas, or regions where the permafrost ground temperatures are close to melting, some method of ventilation or heat removal is necessary to provide a stable, frozen subsoil condition for support of the structure. However, in more northerly

areas, communities or new energy developments are located where the mean ground temperatures are colder than -5\C or so, and another foundation alternative is available to the designer. It is possible using insulation alone, to retain the melting isotherm above the thermally unstable permafrost layer. A thermal analysis for rectangular insulated structures is reviewed, and a new solution for a heated circular insulated structure is presented. A convenient chart allows the designer to select the insulation thickness that will prevent the 0\C isotherm (or any other isotherm) from entering the permafrost subsoil. In addition, an available solution for an insulated buried pipe in permafrost is reviewed for comparison.

115 **Observations of soil and ground ice in pipeline trench excavations in the South Yukon.** Ellwood, J.R.; Nixon, J.F. (Foothills Pipe Lines (Yukon) Ltd., Calgary, Alberta, T2P 2V7). pp 278-282 of Permafrost, Fourth International Conference Proceedings. Washington, DC; National Academy Press (1983). (CONF-830703—).

From 4. international conference on permafrost; Fairbanks, AK, USAe(18 Jul 1983).

During the winter of 1980-1981, Foothills Pipe Lines (Yukon) Ltd. excavated several long trenches in permafrost in order to install sections of 1.22 m diameter pipeline at the Quill Creek test facility in the South Yukon. The authors directed a program of detailed logging of the different soil strata and ground ice formations encountered. A total of 900 linear meters of trench was excavated mostly by wheeled ditcher to a minimum depth of 2 m. The variability in surface peat cover, sand and gravel strata, and a seam of volcanic ash are clearly demonstrated. The ash layer was deposited at a reasonably well-defined date in the recent geological past and therefore allows rates of deposition or growth of surface layers to be established.

0230 Properties

REFER ALSO TO CITATION(S) 91

116 **Interview with Dick Fish.** *LBL Computing Newsletter;* 1-4(Nov-Dec 1984). Contract AC03-76SF00098.

An interview with Dick Fish of the Lawrence Berkeley Laboratory is presented. Mr. Fish's current research interests are discussed. These interests include the identification of trace metal non-porphyrin compounds in heavy crude petroleums. In particular, these interests include the identification of a class of nickel and vanadium compounds in the heavy crude petroleum from various geographical locations, e.g., the Boscan in Cerro Negro in Venezuela, Wilmington in California, and Prudhoe Bay in Alaska.

0240 Storage

REFER ALSO TO CITATION(S) 109

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 86, 119

117 **Future gas contributions from tight sand reservoirs.** Rosenberg, J.I.; Morra, F. Jr.; Marchlik, M. (Gas Research Inst.). pp 76-87 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Increasing future gas contributions from tight sands is a major objective of GRI's R & D program. This paper analyzes the effects of technology, geology, price and risk on future tight gas production. The study indicates that there are a number of possible scenarios which could supply 85x10imc (3x10abscf)--or more--of tight sands gas per year by the year 2000. This could be achieved at wellhead prices consistent with GRI's preliminary 1984 Baseline Pojection and without increasing drilling activity in tight sands areas from recent levels. In all cases, advanced extraction technology through successful R & D offers the best "insurance" for meeting future gas demand with economical supplies over the next several decades.

118 **Rapporteur: Supply.** German, M.I. (American Gas Assoc.). pp 1140-1144 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

This paper discusses conventional and unconventional resources of natural gas in the US. Underfunding and the lack of focus in utilization technologies due to a finite declining resource base that makes investment in gas utilization technologies nonproductive are two areas which are emphasized.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 89

119 (USGS-OFR—84-753, pp 1-5) **Geological characteristics of low-permeability Upper Cretaceous and Lower Tertiary rocks in the Pinedale anticline area, Sublette County, Wyoming: introduction.** Law, B.E. 1984. NTIS, PC A06/MF A01. File Number DE85012200.

In Geological characteristics of low-permeability Upper Cretaceous and Lower Tertiary rocks in the Pinedale anticline area, Sublette County, Wyoming.

This paper discusses the natural gas potential of the Green River Basin of Wyoming and Utah. It centers its review on the Pindale Anticline and gives potential production figures and test well data. Several maps of the Green River Basin are given along with the historical development of natural gas production in the area. Well locations, depths, geologic horizon, and current status of wells are also given.

120 **Gas hydrates at two sites of an active continental margin.** Kvenvolden, K.A. (U.S. Geological Survey). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* SPE13592: 23-30(Mar 1985). (CONF-830512—).

From IEE/APS symposium; Houston, TX, USA (23 May 1983).

Sediment containing gas hydrates from two distant Deep Sea Drilling Project sites (565 and 568), located about 670 km apart or the landward flank of the Middle America Trench, was studied to determine the geochemical conditions that characterize the occurrence of gas hydrates. Site 565 was located in the Pacific Ocean offshore the Nicoya Peninsula of Costa Rica in 3,111 m of water. The depth of the hole at this site was 328 m, and gas hydrates were recovered from 285 and 319 m. Site 568 was located about 670 km to the northwest offshore Guatemala in 2,031 m of water. At this site the hole penetrated to 418 m, and gas hydrates were encountered at 404 m. Both sites are characterized by rates of sedimentation exceeding about 30 m/m.y. and organic carbon contents exceeding about 0.5%. The magnitudes and trends of gas compositions, residual gas concentrations and chlorinity variations are generally similar at both sites. The carbon isotopic compositions are significantly heavier at Site 568 than at Site 565. The isotopic compositions and trends at Site 565 are typical of biogenic methane generation. At Site 568, the isotopic compositions are very heavy. In spite of its heavy carbon isotopic composition, this methane is believed to have a biogenic source.

121 **Porosity and permeability of tight sands.** Randolph, P.L.; Chowdiah, P.; Soedr, D.J. (Inst. of Gas Tech.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* SPE/DOE/GRI 12836: 21-30(Oct 1984). (CONF-8410216—).

From Eastern regional meeting of the Society of Petroleum Engineers; Charleston, WV, USA (31 Oct 1984).

Detailed analyses of more than 50 core samples of western tight sands have resulted in several unanticipated observations that

are set forth in this paper. Core analyses performed under stress representative of producing conditions provided data on porosity, pore volume compressibility, stress dependence of permeability to gas, and slope of the Klinkenberg plot (permeability at constant net stress vs. the inverse of pore pressure). Scanning electron microscope (SEM) and petrographic microscope analyses were performed on samples cut from the ends of core plugs tested. The microscopic studies were explicitly directed toward observing the <0.1 micron flow path openings deduced from permeability data. All samples were from depths that were either known to be gas producers or judged likely to be producers on the basis of wireline log analysis.

122 **Geologic aspects of tight gas reservoirs in the Rocky Mountain region.** Spencer, C.W. (USGS). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE11647**: 399-408(Mar 1983). (CONF-830305—).

From SPE symposium on low permeability; Denver, CO, USA (14 Mar 1983).

This paper reviews some of the characteristics of tight (low-permeability) gas reservoirs in the Rocky Mountains. There are four geologic categories of reservoirs: marginal-marine blanket, lenticular, chalk, and marine blanket shallow. Microscopic study indicates two varieties of tight reservoirs: one owing to fine grain size, the other to relatively tightly cemented rock with poor pore connection. Several other characteristics of tight gas reservoirs are also specified.

123 **A sensitivity analysis of the NPC study of tight gas.** Rosenbery, J.I.; Brashear, J.P.; Mercer, J.; Morra, F.; O'Shea, P. (Gas Research Inst.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE11645**: 387-392(Mar 1983). (CONF-830305—).

From SPE symposium on low permeability; Denver, CO, USA (14 Mar 1983).

The TGAS model now under development is a useful tool to undertake further sensitivity analysis and evaluation on tight sands gas. This paper addreases the issue of economic rent and its implication for early resource development. The analysis of economic rents at the Uinta and Liceance Basins in the Rocky Mountains and the Edwards Lime and Cotton Valley regions of Texas indicates that the greatest near-term development potential appears to be in the Rockies and Texas--despite the preponderance of tight gas assumed by NPC to exist in the Northern Great Plains. The use of risk analysis in estimating resource economics is shown to be particularly important to the R&D community.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 92, 93, 97, 100, 118

124 **Separation of helium-methane mixtures by pressure swing adsorption.** Cheng, H.C.; Hill, F.B. (Brookhaven National Laboratory Upton, NY). *Annali Italiani di Chirurgia;* **31**: No. 1, 95-102(Jun 1985).

The separation of mixtures of helium and methane using a single column of activated carbon in a pressure swing adsorption process was studied experimentally. Process performance was predicted with an average error of 10% or less by a local-equilibrium well-stirred cell model in which dead volumes at the feed and product ends of the column were accounted for. Systematic differences between experiment and model were ascribed to omission from the model of flow resistance and heat release.

0305 Health And Safety

REFER ALSO TO CITATION(S) 1454

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 108, 117, 781, 785, 846

125 **(DOE/EIA—0130(85/08)) Natural Gas Monthly, August 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 17 Oct 1985. 143p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86001830.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1980 through 1985, with monthly data for the most recent 3 years. Some data are also given by state or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Explanatory notes, a discussion of data sources, and a glossary are included. Three reports previously published as separate annuals are now published in this report. The three are "Underground Natural Gas Storage in the United States" (DOE/EIA-0239); "US Imports and Exports of Natural Gas" (DOE/EIA-0188); and "Main Line Sales of Natural Gas to Industrial Users" (DOE/EIA-0129). Featured article for this month is "Natural gas overview: October 1985-March 1986". 6 figs., 32 tabs.

126 **(DOE/EIA—0145(84)) Statistics of interstate natural gas pipeline companies, 1984.** Mack, J. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 23 Oct 1985. 212p. NTIS, PC A10/MF A01 - GPO. File Number DE86001920.

The 1984 financial and operating information presented in this report indicates that the 43 major interstate natural gas pipeline companies reported assests totaling $59.3 billion, as of December 31, 1984, compared with $58.6 billion on December 31, 1983. (In some instances throughout this discussion of financial and operating information, comparative data for 1983 are indicated in parentheses following the amounts shown for 1984.) Gross gas utility plant investments at the end of the year amounted to $42.1 billion ($40.9 billion); and net gas utility plant assets amounted to $20.6 billion ($21.1 billion). The major pipeline companies reported total gas operating revenues of $56.1 billion ($56.8 billion). Sales of natural gas increased from 12.9 trillion cubic feet in 1983 to 13.2 trillion cubic feet in 1984. Sales of natural gas to ultimate consumers increased from 1.3 trillion cubic feet in 1983 to 1.6 trillion cubic feet in 1984. Sales to other gas utilities were 11.6 trillion cubic feet in 1983 and 1984. Revenues from these sales to ultimate consumers increased from $6.0 billion in 1983 to $7.3 billion in 1984. Revenues from sales for resale to other gas utilities amounted to $45.3 billion in 1984 and $47.7 billion in 1983. The total number of natural gas customers was 3,435,602 in 1984, compared with 2,751,197 in 1983. Of these, ultimate consumers totaled 3,432,709 (2,748,260), and there were 2,893 (2,937) wholesale gas utility customers. 12 tabs.

127 **Decision analysis approach to energy system expansion planning.** Peerenboom, J.P.; Foell, W.K. (Argonne National Lab., IL). *Energy Journal;* **6**: No. 3, 21-36(Jul 1985).

In describing a decision analysis framework for treating multiple-objective capacity expansion problems, the authors focus on a case study in which the framework was used to analyze long-range strategies for the development of supplemental gas supply systems for Wisconsin. They compare capacity expansion strategies of four decisionmakers that minimize total discounted system cost and maximize the assessed utility functions, with an emphasis on the policy objectives established for the case study and the quantification of the four decisionmakers' preferences for achieving those objectives. The case illustrates how individuals may disagree on many individual attributes, yet still be in overall agreement on the best policy to adopt. The approach shows that minimization of total dis-

counted system costs may lead to an undesirable capacity expansion strategy. It also provides a record of the rationale that led to a particular decision. 26 references, 3 figures, 3 tables.

128 **Costs of development of U.S. natural gas potential.** Kent, H.C.; Gangwar, A.; Guzman, J.; Jensen, C.; Fisher, C.K.; Thompson, R.G.; Singleton, F.D. (Colorado Sch of Mines, Golden, CO). pp 30-39 of 1984 International Gas Research Conference. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The Mineral Resources Institute of the Colorado School of Mines, in cooperation with Operational Economics, Inc., is completing a project sponsored jointly by Gas Research Institute and Electric Power Research Institute to estimate the costs of development of the U.S. natural gas potential. The cost estimates have been applied to the resource estimates of the U.S. Potential Gas Committee. Based on the resource estimates, postulated resource distributions, field sizes and well recoveries have been developed, together with anticipated success ratios for both exploratory and development wells. Drilling cost data and the costs of other aspects of exploration, development and production have been derived from published sources and from industry estimates. Using methodology developed during the project, the above data have then been used to estimate the costs of development in 1980 constant dollars. The analysis of a number of geologic provinces in the United States indicates that the average cost of development of most of these provinces will range between $0.40 and $6.52 per Mcf (thousand cubic feet) with 99% of the resource less than $5.00 per Mcf average cost. Marginal costs range from $0.26 to $137.28 per Mcf with 92% of the resource less than $5.00 per Mcf marginal cost.

129 **Outlook for U.S. natural gas consumption in the production of methane-based chemicals.** Samsa, M.E.; Hedman, B.A. (Gas Research Inst.). pp 803-812 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The future of natural gas consumption by the U.S. petrochemical industry has been a topic of growing concern in the natural gas industry over the past several years. Natural gas consumption in the petrochemical industry has been declining as a result of reduced refinery throughput, process efficiency improvements, and a drop in production of many intermediate and finished chemical products. This paper focuses on the economic, market, and technology questions for natural gas use as a chemical feedstock. It reviews important factors determining the future of gas consumption in this segment of the petrochemical industry and provides a perspective on the relative magnitude of each in determining this future. The paper concludes that the overriding determinants governing the future of bulk chemicals from methane are relatively high U.S. natural gas prices and strong efforts by major oil-producing nations to export high value-added products derived from natural gas.

130 **Trends and projections as tools for research and development planners.** Bernstein, H.M.; Harris, L.R. (Applied Management Sciences). pp 1013-1022 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Research and development planners are faced with the problem of uncertainty when establishing objectives and justifying resources to support R & D plans. This paper presents a three-step methodology to aid R & D planners in developing experience curves that can help identify trends and future product planning implications. Key to the methodology is the belief that in all probability historic trends and key observations offer insights for the passage of a future technology through the seven stages of the R & D process. The type of experience curves developed with the methodology and illustrated in this paper are: new technology development; technology enhancements; and unit price and volume curves. The emphasis is on the market for natural gas.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 1271, 1454

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 61, 94, 95, 101, 102, 118, 279

131 **Devonian shale gas production mechanisms.** Kuuskraa, V.A.; Wicks, D.E. (Lewin and Associates, Inc.). pp 128-139 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

This paper provides an overview of the mechanisms beyond the conventional reservoir parameters that control production in the Devonian Shales, including fracture permeability and intensity, anisotropy (directional permeability), dual porosity (consisting of matrix and fractures), adsorbed gas (released as a function of pressure), non-measurable (by conventional means) net productive internals, and capacity to connect natural fracture systems to wellbore. The paper also analyzes alternative production strategies. Traditional development of the Devonian Shale has used borehole shooting and uncased wells on 160-acre spacing. Currently, several new technologies and development practices are emerging that can lead to increased recovery and lower cost gas. Three such alternative production strategies are: 1) advanced well stimulation technology, 2) reduced pattern size, and 3) alternative pattern shape.

132 **The development of coalbed methane gas in the state of Alabama: A spatio-economic analysis.** Richetto, J.P.; Gunther, T.M.; Holland, J.R. (The Univ. of Alabama). pp 209-218 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The development potential of coalbed methane gas in the Warrior Coal Field is contingent upon supply/demand economics, available markets, mining and gas technology, and environmental and political considerations. By focusing on the first two of the above issues, this paper attempts to (1) develop baseline data for identifying and evaluating geographical areas containing the highest densities of logical coal gas users and (2) estimate the economic impacts associated with coal gas development, 1983-1991. Based upon the present and projected natural gas consumption, industrial park activity and level of interest in utilizing coal gas exhibit a concentrated pattern along the eastern edge of the Warrior Coal Field (extending from Madison County in the north to Tuscaloosa County in the south), initial development efforts should also display a similar spatial orientation. Also, due to high levels of gas consumption, target industries should include textiles, primary and fabricated metals, chemicals and food and kindred products.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 113

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 114, 115

133 **(MIT-EL—84-017) Internal seal for repairing natural gas mains.** Cooper, S.A.; Glicksman, L.R.; Peterson, C.R. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Sep 1984. 141p. Massachusetts Institute of Technology, Energy Lab., Cambridge, MA. File Number TI85902102.

Joint leakage from low pressure natural gas distribtuion mains is a persistent source of maintenance problems for utilities. External encapsulation is the usual choice for repairing leaking

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joints. It is reliable and expensive, about $1000 per joint (80% of which is for excavation and resurfacing). Consolidated Edison of New Yoek is sponsoring a project to develop a cheap and reliable joint seal. No current sealing methods were found to be acceptable in Phase I. Adhesion failures between the seal and pipe were a major cause of seal failure. Preliminary Phase II research recommended the development of an internal mechanical seal. Such a seal would minimize excavation and eliminate adhesion failures. To complete Phase II, an internal mechanical seal was developed. The initial research indicated that cleaning of the pipe interior had to be minimized or eliminated. Testing demonstrated that a sealant, either asphalt or vulcanizing silicone, greatly enhanced the sealing of uncleaned pipes, while permitting low stress levels. This led to the development of a new internal mechanical seal concept for sealing uncleaned gas main joints. Joint tests of 2 injected silicon seal concepts were run. The Type 1 seal, which filled the joint recess, completely sealed an uncleaned pipe joint. The Type 2 seal, which spanned the joint recess with an elastomeric bridge, had a leak rate of 0.000038 ft^3/h at 6 inwg gas pressure from an uncleaned joint. The leakage was caused by permeability of the silicone bridge. These flexible and compliant seals, clamped in place with retaining bands, provide mechanical support for the sealant throughout the seal life, and thus do not rely on adhesion. 44 figs., 7 tabs.

134 **(ULV-RK-GP—42611) Project-Gas transit - 3. Finite element method calculations of temperature fields surrounding a dug down gas-pipe. Preliminary results.** Karlsson, R.; Szentivanyi, D. (Swedish State Power Board, Aelvkarleby). Mar 1983. 25p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752736.

Two cases have been treated, namely Malmoe, where the gas temperature is lower than the ground, and Kiruna where the gas temperature is high. In the first case the influence on ground temperature is very small. The second case is more complicated; the calculation model not being equivalent to the physical reality. Snow is expected to melt above the pipe, the excess temperature being 5 to 10 degrees C at the depth of 0.1 m above the pipe.

0330 Properties

REFER ALSO TO CITATION(S) 120

135 **The effects of gas composition and geothermal properties on the thickness and depth of natural gas hydrate zones.** Holder, G.D.; Lawson, W.F.; Malone, R.D. (Univ. of Pittsburgh). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13595**: 51-58(Mar 1985). (CONF-830512—).

From IEE/APS symposium; Houston, TX, USA (23 May 1983).

When natural gas and water are contacted at low temperature and high pressure, gas hydrates can form. In colder climates (such as Alaska, Northern Canada, and Russian Siberia) and beneath the earth's oceans, conditions are appropriate for gas hydrate formation. This paper gives the depths and potential thickness of such hydrate formations as a function of the geothermal gradient, the gas composition, and where appropriate, the permafrost thickness, the pressure gradient, and the ocean bottom temperature.

0340 Combustion

REFER ALSO TO CITATION(S) 823

136 **(UCRL—93362) Successive reignition of fuel-air mixtures and pulse combustion.** Westbrook, C.K. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 27p. (CONF-8510158—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001560.

From Two phase combustion, numerical modelling of combustion processes: general combustion topics; Davis, CA, USA (21 Oct 1985).

Chemical kinetic modeling of the successive reignition of fuel-air mixtures is described, under conditions of pressure and temperature very similar to those encountered in conventional pulse combustion systems. The overall system model is described and the kinetic model is discussed in some detail. Computed results for ignition delay times are then related to time scales of interest in pulse combustion. From these comparisons, some of the physical and chemical factors which control the operation of the pulse combustor can be identified and quantified. In addition, the dependence of pulse combustor performance on various system parameters can be addressed, including the mass flow rate, fuel composition, presence of selected diluents and inhibitors, and combustion chamber geometry. 18 refs., 3 figs., 1 tab.

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 131

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 131

137 **(CAPE—2962) [Haspert oil shale mining system] (Engineering Materials).** Haspert, J. (Underground Systems, Arcadia, CA (USA)). [1982]. Contract FG01-80CS15006. TIC, PO Bx 62, Oak Ridge, TN 37831. File Number TI86002281.

NONE

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 140

0405 Properties And Composition

138 (CONF-840408—, pp 457-468) **Application of the Los Alamos nuclear microprobe to the characterization of trace element-mineral associations in geologic materials and solid wastes.** Benjamin, T.M.; Rogers, P.S.Z.; Peterson, E.J.; Wangen, L.E. (Los Alamos National Lab., NM). Apr 1984. NTIS, PC A99/MF A01. File Number DE84017348.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

The Los Alamos nuclear microprobe is being used to characterize the oil shale matrix and other geologic samples that influence the mobility and transport/attenuation of environmental contaminants. A series of preliminary experiments have been conducted to test the usefulness of particle-induced x-ray emission (PIXE) to the investigation of trace element residences in the oil shale mineral assemblage. Elemental concentrations and detection limits from the PIXE analysis of a raw and a spent oil shale are reported for 36 elements. Detection limits for most elements are in the range of 2 to 30 $\mu g/g$, showing that the PIXE technique is a suitable method for broad-spectrum trace element analysis in geologic samples. These detection limits are compared to a PIXE analysis of coal mineral matter, a much simpler matrix, and are an order of magnitude higher. This is due to the percent level concentrations of calcium, iron, aluminum, and potassium in the oil shale matrix. Two areas on the raw and spent shales were analyzed. Although the two areas on the spent shale were quite similar in both major and trace element composition, the two areas on the raw shale showed interesting differences. One area on the raw sample was obviously carbonate rich, whereas the other was feldspar/clay rich.

139 **Application of dielectric spectroscopy to chemical characterization of oil shales.** Rajeshwar, K.; Inguva, R. (Department of Chemistry, The University of Texas at Arlington, Arlington, TX). *Fuel;* **64**: No. 7, 931-937(Jul 1985).

Simple models to predict the variation of dielectric parameters for Green River oil shale with selected variables, are presented. The relative dielectric constant, ϵ, was chosen as a representative parameter for these computations. A composite ϵ value was de-

rived for the shale matrix while simultaneously varying shale organic content, moisture content, porosity and mineral composition. Both linear and logarithmic averaging methods were utilized to arrive at these composite ϵ values. In addition, the influence of organic pyrolysis and thermal alterations in the mineral matrix on the composite ϵ value for the shale matrix, were considered. Comparison with experimental results are presented where possible. The utility of these model predictions for assay and diagnostic applications in oil shale technology is described.

140 **Identification by ^{13}C n.m.r. of carbon types in shale oil and their relation to pyrolysis conditions.** Ward, R.L.; Burnham, A.K. (University of California, Lawrence Livermore National Laboratory, Livermore,). *Fuel;* 63: No. 7, 909-915(Jul 1984).

A number of samples of shale oil prepared under various conditions have been examined by ^{13}C n.m.r. using multiple-pulse techniques that allow carbon-type assignments. Previous assignments by Netzel et al. (Fuel 1981, 60, 307) are confirmed and several new ones made. Product chemistry is then examined as a function of heating conditions. New or verified observations are: isoprenoids are evolved in the early stages of oil generation, and the average length of normal hydrocarbons in the evolved oil i approximately independent of the extent of kerogen conversion; alkene content depends strongly on the heating rate during pyrolysis but average normal chain length does not; and the ratio of isoprenoid to normal carbons and the average normal chain length in bitumen are greater than in shale oil, but there are greater questions about the correct equation for calculating the average normal chain length of bitumen.

0407 Health And Safety

REFER ALSO TO CITATION(S) 1013

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 472, 473

0501 Reserves

REFER ALSO TO CITATION(S) 1496

141 **Ages of major uranium mineralization and lead loss in the Key Lake uranium deposit, northern Saskatchewan, Canada.** Trucki, L.K.; Banar, J.C.; Curtis, D.B.; Gancarz, A.J. (Geosciences Department, Pennsylvania State University, University Park, Pennsylvania). *Economic Geology and the Bulletin of the Society of Economic Geologists;* 79: No. 6, 1378-1386(Sep 1984).

Uranium and lead isotope ratios were measured on nine ore samples and four mineral separates from the Deilmann orebody of the Key Lake uranium-nickel deposit. The time of primary mineralization is the oldest reported for Proterozoic unconformityrelated uranium deposits in the Athabasca basin. Data obtained in this study show that lead loss (or uranium gain) has occurred in high-grade rocks and that lead gain (or uranium loss) has occurred in low-grade rocks. Lead loss rather than uranium gain in high-grade ore is suggested by the petrologic work of Cumming and Rimsaite and the presence of excess radiogenic lead in the overlying sandstone documented by Curtis and Gancarz. Some of the results obtained in this study provide evidence of preferential movement of ^{238}U intermediate daughters out of uranium minerals and into the matrix.

0503 Mining

REFER ALSO TO CITATION(S) 218, 1246

0504 Feed Processing

REFER ALSO TO CITATION(S) 212

142 (INIS-mf—9910-Vol.2, pp 5-37) **Yellow cake to ceramic uranium dioxide. A review of the process, problems and solutions.** Zawidzki, T.W.; Itzkovitch, I.J. (Eldorado Nuclear Ltd., Port Hope, Ontario (Canada). Research and Development Div.). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

This overview article first reviews the processes for converting uranium ore concentrates to ceramic uranium dioxide at the Port Hope Refinery of Eldorado Resources Limited. In addition, some of the problems, solutions, thoughts and research direction with respect to the production and properties of ceramic UO_2 are described.

0505 Enrichment

143 (INIS-mf—9910-Vol.1, pp 63-96) **Status and prospects for large-scale laser isotope separation.** Davis, J.I. (Lawrence Livermore National Lab., CA (USA)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The use of lasers for uranium and/or plutonium isotope separation is expected to be the first large-scale application of lasers to bulk materials processing. The nature of the laser isotope separation process provides insight into the type of applications and character of laser systems that are necessary for future large-scale laser-based industrial processes. Applications and rumors of applications of lasers in chemical or material processing are legion. However, the only large-scale application that has thus far received serious investment is isotope separation, especially of the actinides. The unusually high value ($>=10^3$ $/kg) of these isotopes when contrasted with bulk chemicals (approximately 1 $/kg) explains the motivation. The efficacy of lasers in a far wider range of applications is not really in doubt, but the economics of laser operation, both capital and operating costs, is a barrier to wider utilization. Of course, unfamiliarity with the technology, viz., safety, trained operators, and maintenance personnel is also a barrier. The author discusses some general requirements for laser applications and reviews some specific accomplishments and the approach taken in the atomic vapor laser isotope separation (AVLIS) program at Lawrence Livermore National Laboratory.

144 **(UCRL—92975) Real time analysis under EDS.** Schneberk, D. (Lawrence Livermore National Lab., CA (USA)). Jul 1985. Contract W-7405-ENG-48. 20p. (CONF-8509152—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85016944.

From Information crossroads of the 80's; Washington, DC, USA (8 Sep 1985).

This paper describes the analysis component of the Enrichment Diagnostic System (EDS) developed for the Atomic Vapor Laser Isotope Separation Program (AVLIS) at Lawrence Livermore National Laboratory (LLNL). Four different types of analysis are performed on data acquired through EDS: (1) absorption spectroscopy on laser-generated spectral lines, (2) mass spectrometer analysis, (3) general purpose waveform analysis, and (4) separation performance calculations. The information produced from this data includes: measures of particle density and velocity, partial pressures of residual gases, and overall measures of isotope enrichment. The analysis component supports a variety of real-time modeling tasks, a

means for broadcasting data to other nodes, and a great degree of flexibility for tailoring computations to the exact needs of the process. A particular data base structure and program flow is common to all types of analysis. Key elements of the analysis component are: (1) a fast access data base which can configure all types of analysis, (2) a selected set of analysis routines, (3) a general purpose data manipulation and graphics package for the results of real time analysis. Each of these components are described with an emphasis upon how each contributes to overall system capability. 3 figs.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 1136

145 **(RFP—3827) Evaluation of the analysis of plutonium materials for low-level uranium using a modified Scintrex uranium analyzer (laser fluorometer).** Michel, C.E.; Weiss, J.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 25 Sep 1985. Contract AC04-76DP03533. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000880.

Evaluation and analysis of low-level uranium in plutonium materials using a modified Scintrex UA-3 Uranium Analyzer are described. Two liquid/liquid procedures for the separation of uranium from plutonium are compared. They are 0.1M tri-n-octylphosphine oxide (TOPO) in cyclohexane and 20% (v/v) tributyl phosphate (TBP) in 2,2,4-trimethylpentane (iso-octane). 7 refs., 1 fig., 3 tabs.

146 **Critical review of the thermophysical properties of fast-reactor fuel.** Fink, J.K. (Argonne National Laboratory, Argonne, IL). *Journal of the American Ceramic Society;* **68**: No. 3, 139-142(Mar 1985).

This paper identifies the fuel properties for which more data are needed for fast-reactor safety analysis. In addition, a brief review is given of current research on the vapor pressure over liquid UO_2 and (U,Pu)O /sub 2-x/, the solid-solid phase transition in actinide oxides, and the thermal conductivity of molten uranium.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 145, 231, 1136

147 **(DOE/NBM—5017991) Coprocessing of thermal reactor fuels.** Ballard, W.W. Jr. (Department of Energy, Washington, DC (USA). Div. of Nuclear Power Development). [1985]. 16p. (DOE—010). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85017991.

The Nuclear Power Development Division (NPD) under the Assistant Secretary for Energy Technology in the Department of Energy (DOE) is responsible for examining alternative nuclear reactor fuel recycle systems which have potential for reducing the risk of proliferation of nuclear weapons. NPD is administering a base technology program of research and development and design studies which will provide a sound technical foundation for evaluating the nonproliferation potential and commercial feasibility of these alternatives. The Savannah River Laboratory (SRL) has been assigned as the technical lead for those activities associated with the processing of thermal reactor fuel. In order to systematically identify technical requirements and design solutions, SRL periodically updates a Design Integration Study (DIS). The reference process being incorporated into the current DIS is coprocessing uranium and plutonium in a manner whereby pure plutonium is never available in a separate stream. As with other processes, coprocessing doesn't offer a technical fix for preventing proliferators. A flowsheet for this reference process is described with particular emphasis on technical issues and proliferation resistance advantages of coprocessing over conventional Purex processing.

148 **(FRNC-TH—2042) Contribution to the study of liquid-liquid extraction kinetics for rapid transfers.** Jacouen, C. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). 1979. 114p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752875.

Recovery and purification of U and Pu from spent fuels by liquid-liquid extraction with TBP from a nitric solution are reviewed. Evolution of equipment is briefly examined, in pulsed columns and centrifuge extractors the time of contact is short and efficiency of the extraction process requires to take into account the kinetics of transfer of compounds in solution. Determination of the kinetics of U and Pu extraction is studied with laboratory centrifuge extractors.

149 **(RHO-PB-SR—10-B-CP) Chemical processing programs. Monthly status report, May 1985.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1985. Contract AC06-77RL01030. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001940.

In the PUREX/UO_3 operations, 50 tonnes of N reactor fuel were charged to the PUREX dissolvers in May. Production has fallen behind the 1200 tonne plan due to an extended shutdown during May to resolve the L-cell line pluggage problem. Extensive component and line flushing and selected line vibrations were completed and 20 tonnes of the remaining cooled Mark IV fuel and 30 tonnes of Mark IA fuel were charged. This brings the fiscal year-to-date (FYTD) total charges to 717 tonnes versus a plan of 843. 41 tonnes of uranium trioxide were shipped to the Feed Materials Production Center bringing the FYTD total to 658 tonnes. 7% of the planned FY 1985 plutonium dioxide shipments were achieved during May bringing the cumulative shipments to 59%. Ventilation control/safety upgrade for nitrate loadout-PUREX is nearly complete. In the Plutonium Finishing (PF) plant/nuclear materials management program, the Plutonium Reclamation Facility (PRF) completed load-out of the initial weapons grade campaign. 53% of the original target nitrate or this campaign was loaded out by May 31, 1985. Remote Mechanical C (RMC) metal line reactivation activities are on schedule for a July 1 startup. Terminal Cleanup Operations (TCO) continue approximately one month behind schedule due to diversion of personnel previously planned for TCO to the RMC reactivation effort. Construction on Project B-339, Vault Safety and Inventory System was initiated on schedule.

150 **(RHO-PB-SR—10-B-CP-1) Chemical Processing monthly report, April 1985.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1985. Contract AC06-77RL01030. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001942.

In the PUREX/UO_3 operations, 151 tonnes of N reactor fuel were charged to the PUREX dissolvers in April 1985, bringing the Fiscal Year-to-Date (FYTD) total to 667, which is now only 61 tonnes behind the 1200 tonne recovery plan. 139 tonnes of UO_3 were shipped to the Feed Materials Production Center (FMPC), bringing the FYTD total to 644 tonnes. 22% of the PUO_2 shipments were achieved, bringing the cumulative shipments to 52%. In the plutonium finishing (PF) plant/nuclear materials management program, 10% of plutonium nitrate was loaded out. Total Operating Efficiency for Plutonium Reclamation Facility (PRF) was 53% for the month, compared to a goal of 70%. Remote Mechanical C (RMC) metal line reactivation activities are 95% complete. Terminal clean out operations are about one month behind schedule, due to diversion of personnel to the RMC reactivation effort. Within the area of decontamination and decommissioning activities, removal of the Sorter/Chopper hood in 232-Z Building was completed. Design on B-339, vault safety and inventory system was completed on schedule.

151 **(LA-tr—85-48) Evaluation and presentation of analysis methods for reception analysis in reprocessing.** Mainka, E. (Los Alamos National Lab., NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1985. Contract W-7405-ENG-36. Translation of KfK-3290, pp 217-227, 1981. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001257.

The fissile material content in the dissolving or balancing tank of a reprocessing plant has special significance in nuclear fuel balancing. This is the first opportunity for destructive analysis of the fuel content of the material after burn-up of fuel elements in the reactor. In the current state-of-the-art, all balancing methods are

based directly or indirectly on data obtained by chemical analysis. The following methods are evaluated: Mass-spectroscopic isotope dilution analysis, X-ray fluorescence spectroscopy, Isotopic correlation, Gamma absorptiometry, Redox titration, Emission spectroscopy after plasma excitation, Alpha spectroscopy, and Laser Raman spectroscopy.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 1167, 1356

152 **(CONF-860604—1) Personal computer program for evaluating the impact of proposed cask design specifications.** Bucholz, J.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001337.

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Shipments of spent fuel to the Monitored Retrievable Storage (MRS) facility may be minimized by developing a new generation of truckand rail casks. Specifications for such casks are now being prepared. While such specifications must be consistent with long-term economic, logistical, and operational goals, they must not be overly restrictive. A new interactive program called CAPSIZE has therefore been written for the IBM-PC to rapidly determine the likely impact that proposed criteria might have on the size and capacity of casks designed to meet those criteria.

153 **(DOE/RL—85-2) Spent fuel storage capacities. An update of DOE/RL-84-1.** (USDOE Richland Operations Office, WA). Oct 1985. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001782.

Spent fuel storage capacities at some commercial light water reactors (LWRs) are inadequate to handle projected spent fuel discharges. This report presents estimates of potential near-term requirements for additional LWR spent fuel storage capacity, based on information supplied by utilities operating commercial nuclear power plants. These estimates provide information needed for planning the Department of Energy's (DOE) activities to be carried out under the DOE's Commercial Spent Fuel Management (CSFM) Program, in conjunction with the requirements of the Nuclear Waste Policy Act of 1982. The estimates in this report cover the period from the present through the year 2000. Although the DOE objective is to begin accepting spent fuel for final disposal in 1998, types of fuel and the receipt rates to be shipped are not yet known. Hence, this report makes no assumption regarding such fuel shipments. The resport also assesses the possible impacts of increased fuel exposure and spent fuel transhipment on the requirements for additional storage capacity.

154 **(INIS-mf—9363) Record of discussions in full wording: hearing on the Ahaus storage facility for spent-fuel transport containers, June 21-29, 1983. Hearing concerning a project of the Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen mbH, Hannover, and STEAG Kernenergie GmbH, Essen, to establish a long-term storage facility for spent-fuel transport containers in Ahaus, Landkreis Borken, Nordrhein-Westfalen. Pt. 3. 28-29 Jun 1983.** (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). 1984. 530p. (In German). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780041.

This third part of the record of the Ahaus Hearing presents the full wording of the discussions and statements concerning the topics of radiation protection and protection of the environment during operation of the planned facility. The problems considered can be summarized under the following keynotes: wastes, effluents, environmental monitoring, radiological protection of workers, micro-climate, accidents and their impacts on the environment, site selection, development trends, physical protection, emergency service. The final debates are concerned with the radwaste disposal and management concept of the Federal German Government, with alternative methods or techniques for waste storage, and with the transport of radwaste. The hearing was organized by the PTB in its capacity as a licensing authority under atomic energy law, and this organisation will be responsible of examining and evaluating the objections stated with a view to the requirements set by section 6 of the Atomic Energy Act. (HSCH).

155 **(NUREG—0383-Vol.3-Rev.5) Directory of Certificates of Compliance for Radioactive Materials Packages. Summary Report of NRC Approved Quality Assurance Programs for Radioactive Material Packages. Volume 3. Revision 5.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety). Oct 1985. 126p. NTIS, PC A07/MF A01 - GPO. File Number TI86900250.

This directory contains a Summary Report of the US Nuclear Regulatory Commission's Approved Packages (Volume I), all Certificates of Compliance (Volume 2), and Summary Report of NRC Approved Quality Assurance Programs (Volume 3) for Radioactive Material Packages effective October 1, 1985. The purpose of this directory is to make available a convenient source of information on packagings which have been approved by the US Nuclear Regulatory Commission. To assist in identifying packaging, an index by Model Number and corresponding Certificate of Compliance Number is included at the back of Volumes 1 and 2 of the directory. A listing by packaging types is included in the back of Volume 2. An alphabetical listing by Company name is included in the back of Volume 3 for approved QA programs. The Summary Reports include a listing of all users of each package design and approved QA programs prior to the publication date of the directory. Shipments of radioactive material utilizing these packages must be in accordance with the provisions of 49 CFR Section 173.471 and 10 CFR Part 71, as applicable. In satisfying the requirements of Section 71.12, it is the responsibility of the licensees to insure themselves that they have a copy of the current approval and conduct their transportation activities in accordance with a Nuclear Regulatory Commission approved quality assurance program. Copies of the current approval may be obtained from the US Nuclear Regulatory Commission Public Document Room files (see Docket No. listed on each certificate) at 1717 H Street, Washington, DC 20555. Note that the general license of 10 CFR Section 71.12 does not authorize the receipt, possession, use or transfer of byproduct, source or special nuclear material; such authorization must be obtained pursuant to 10 CFR Parts 30 to 36, 40, or 70.

156 **(NUREG/CR—1117) Method for determining radioactive material shipment patterns in urban areas.** Herreid, S.F.; Finley, N.C.; Ritchie, L.T. (Sandia National Labs., Albuquerque, NM (USA)). May 1981. Contract AC04-76DP00789. 200p. (SAND—79-2071). NTIS, PC A09/MF A01 - GPO $6.00. File Number TI86000898.

This report details the development of representative sets of radioactive material shipments into, out of, and through a number of densely populated urban areas. These data represent a large portion of the information required for the assessment of the risks associated with the transportation of radioactive materials in these urban settings. Standard shipment models have been developed for twenty highly populated urban areas, using background data from a 1975 survey of shippers of radioactive materials. These models and the methods and assumptions required for their formulations are presented. Each shipment is specified by the material shipped (nuclide), transport mode, number of shipments per year of that type, size of shipment (curies), transport index (TI), package type, physical form, and material end use (medical/research, industrial, fuel cycle, and waste). 6 refs., 45 tabs.

157 **(NUREG/CR—2216) Institutional issues associated wsith spent fuel storage under domestic and international auspices.** O'Brien, J.N. (Brookhaven National Lab., Upton, NY (USA)). Sep 1981. Contract AC02-76CH00016. 62p. (BNL-NUREG—51413). NTIS, PC A04/MF A01 - GPO. File Number TI86000974.

This report examines the various institutional issues associated with the establishment of away-from-reactor (AFR) spent fuel storage. Technical factors contributing to the problem of spent fuel congestion are briefly reviewed and differing projections of capacity shortfalls are discussed. Chapter II analyzes the institutional considerations pertinent to the establishment of a domestically con-

structed and operated AFR facility. This chapter discusses facility characteristics, federal agency jurisdictions, the state/federal interface, and financial arrangements. Chapter III discusses the problems associated with establishment of an AFR storage facility under international auspices. This chapter discusses international auspices, appropriate compensation for energy content, and sovereign immunity. A comprehensive description of the organization and structure of international organizations is presented. Recommendations are made for the organization and structure of an international AFR.

158 **(NUREG/CR—4345) Investigation of the stability of LWR spent fuel rods below 250°C.** Olsen, C.S. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1985. Contract AC07-76ID01570. 149p. (EGG—2409). NTIS, PC A07/MF A01 - GPO. File Number TI86001854.

A testing program was conducted to investigate the long-term stability of commercial pressurized-water-reactor (PWR) and boiling-water-reactor (BWR) spent fuel rods under a variety of possible dry storage conditions. The objective of this project is to provide the Nuclear Regulatory Commission (NRC) with an experimental basis to evaluate the results of short-term, high-temperature tests and to establish a licensing position for long-term, low-temperature (<250°C) spent fuel rod dry storage. A total of nine fuel rods (five BWR and four PWR) were nondestructively examined after interim heating periods, and seven of these fuel rods were destructively examined to determine the degradation of the fuel rods during the long-term, low-temperature dry fuel storage. The results of the nondestructive examinations of all nine fuel rods and the destructive examination of one fuel rod were reported previously. This report presents detailed results of the destructive examinations of six of the remaining fuel rods, with brief descriptions of the examinations of all the test fuel rods as they pertain to the fuel rod behavior during dry spent fuel storage conditions.

159 **(ORNL/TM—9563) Transportation of radioactive and hazardous materials: a summary of state and local legislative requirements for the period ending December 31, 1984.** Knox, N.P.; Goins, L.F.; Owen, P.T. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 257p. NTIS, PC A12/MF A01; GPO Dep. File Number DE86001866.

This report summarizes 513 adopted US state and local laws that impact the transportation of radioactive materials. The report was generated from legislative information contained in the Legislative Data Base (LDB), a comprehensive interactive database developed at the Oak Ridge National Laboratory for the US Department of Energy. The annotated citations alphabetically by state, with state and local bills listed separately and sorted by date of adoption. Each citation contains the following information: locale (geographical areas and political jurisdictions affected by the action), bill number, bill title, bill sponsor, history of bill status, comments, and abstract. Six indexes are provided to assist the reader in locating legislation of interest: locale index, bill number index, title word index (permuted), sponsor index, transport restriction index (type of transportation restriction specified, e.g., escort, notify, permit, ban), transport mode index (mode of transportation specified, e.g., truck, rail, barge), and keyword index. This report updates the information contained in Transportation of Radioactive and Hazardous Materials: A Summary of State and Local Legislative Requirements for the Period ending September 30, 1983, ORNL/TM-8860 (TTC-0485), published in June 1984.

160 **(PNL—5569) Assessment of nitrogen as an atmosphere for dry storage of spent LWR fuel.** Gilbert, E.R.; Knox, C.A.; White, G.D. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 54p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001944.

Interim dry storage of spent light-water reactor (LWR) fuel is being developed as a licensed technology in the United States. Because it is anticipated that license agreements will specify dry storage atmospheres, the behavior of spent LWR fuel in a nitrogen atmosphere during dry storage was investigated. In particular, the thermodynamics of reaction of nitrogen compounds (expected to form in the cover gas during dry storage) and residual impurities (such as moisture and oxygen) with Zircaloy cladding and with spent fuel at sites of cladding breaches were examined. The kinetics of reaction were not considered it was assumed that the 20 to 40 years of interim dry storage would be sufficient for reactions to proceed to completion. The primary thermodynamics reactants were found to be NO_2, N_2O, H_2O_2, and O_2. The evaluation revealed that the limited inventories of these reactants produced by the source terms in hermetically sealed dry storage systems would be too low to cause significant spent fuel degradation. Furthermore, the oxidation of spent fuel to degrading O/U ratios is unlikely because the oxidation potential in moist nitrogen limits O/U ratios to values less than UO/sub 2.006/ (the equilibrium stoichiometric form in equilibrium with moist nitrogen). Tests were performed with bare spent UO_2 fuel and nonirradiated UO_2 pellets (with no Zircaloy cladding) in a nitrogen atmosphere containing moisture concentrations greater than encountered under dry storage conditions. These tests were performed for at least 1100 h at temperatures as high as 380°C, where oxidation reactions proceed in a matter of minutes. No visible degradation was detected, and weight changes were negligible.

161 **(SAND—84-7122) Specification for procurement and fabrication of TRUPACT-I auxiliary equipment.** Meyer, R.J. (GA Technologies, Inc., San Diego, CA (USA)). Sep 1985. Contract AC04-76DP00789. 50p. (GA-A—17425; TTC—0453). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002102.

Operation of the TRansUranic PACkage Transporter (TRUPAC) requires the use of specific auxiliary equipment for loading, unloading, handling, packing, and leak testing. Descriptions and specifications are presented for the following equipment: loading platforms, leak testing equipment, protective covers for door seals, dunnage, and general handling devices. Quality Assurance requirements for equipment procurement are identified.

162 **(PNL-TR—453) Study of long-term influences of intact spent fuel rods exposed to conservative dry-storage conditions. Final report, April 1, 1982-October 31, 1984.** Porsch, G. (Pacific Northwest Labs., Richland, WA (USA); Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.)). 24 Sep 1985. Contract AC06-76RL01830. Translation of FUE-84027, March 1985. 228p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86001606.

In cooperation with DWK, KWU, and the Ispra Research Center, a dry-storage experiment was carried out with 10 spent PWR and 15 spent BWR fuel rods. The storage temperatures ranged up to 450°C, the storage time extended over three cycles with a total duration of 16.5 months. The experimental work was conducted with specially developed test equipment in the hot cells at the ESSOR Reactor in the research center operated by the European Community in Ispra, Italy. The gamma-spectrometric analyses of the storage atmospheres ruled out any defect during the storage. Visual inspections and eddy current tests after storage confirmed the integrity of the test material. The krypton-85 activity detected in the storage atmosphere inside the container holding BWR fuel rods could be attributed to a contamination of the fuel rod surface with uranium. During absolutely oxygen-free storage, the thickness of the oxide layer remained unchanged, while during storage with a limited amount of oxygen available it was possible to correlate the increase in thickness of the oxide layer with the amount of oxygen consumed. The creep of the cladding tube remained in all less than one percent. Quantitatively, the results can be described to a good approximation by an empirical creep formula. By means of beta-spectrometric analyses of the storage atmospheres, it was possible to detect tritium in the chemical compounds HT and HTO. The equilibrium concentrations calculated with a simple model (Sieverts' Law) showed good agreement between theory and experiment. A fuel rod internal pressure measurement made at eight rods, and metallographic studies of cladding tube sections, completed the experimental program. 13 refs.

0510 Marketing And Economics

163 **(DOE/EIA—0477) Domestic uranium mining and milling industry. 1984 viability assessment.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 10 Sep 1985. 161p. NTIS, PC A08/MF A01; 1 - GPO; GPO Dep. File Number DE86001141.

This report presents the second annual assessment of the domestic uranium mining and milling industry's resource capability, supply response capability, financial capability, and import commitment dependency. The data and analysis in support of this assessment and the report itself have been developed pursuant to requirements set forth in Section 23(b) of Public Law 97-415, the Nuclear Regulatory Commission (NRC) Authorization Act, which was enacted on January 4, 1983. The report provides information on recent uranium supply, demand, and marketing conditions and projections of the domestic uranium industry's ability to continue to supply the needs of the domestic nuclear power industry through the year 2000. Industry capability is assessed under a variety of assumed conditions with respect to hypothetical disruptions of uranium imports.

164 **(DOE/EIA—0478(84)) Uranium Industry. Annual 1984.** Lawrence, M.S.S. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 22 Oct 1985. 152p. NTIS, PC A08/MF A01; 1 - GPO; GPO Dep. File Number DE86002041.

This report provides a statistical description of activities of the US uranium industry during 1984 and includes a statistical profile of the status of the industry at the end of 1984. It is based on the results of an Energy Information Administration (EIA) survey entitled "Uranium Industry Annual Survey" (Form EIA-858). The principal findings of the survey are summarized under two headings - Uranium Raw Materials Activities and Uranium Marketing Activities. The first heading covers exploration and development, uranium resources, mine and mill production, and employment. The second heading covers uranium deliveries and delivery commitments, uranium prices, foreign trade in uranium, inventories, and other marketing activities. 32 figs., 48 tabs.

165 **(IFP—32-603-Pt.1) Balance of the uranium market. Contribution to an economic analysis. Vol. 1.** Ehsani, J. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; Paris-2 Univ., 75 (France)). Nov 1983. 338p. (In French). NTIS (US Sales Only), PC A15/MF A01. File Number DE85752878.

The evolution of the economic and the energetic world situation for these last 40 years are first described stressing electricity production. The place of nuclear energy in the energy market is analyzed taking into account socio-political factors. In a second part, cost for electricity production from different sources: coal, nuclear power, fuel-oil are compared. Two models for uranium world supply and demand are developed. In the third part the uranium market balance, is examined. The analysis includes 3 steps: determination of total uranium demand from 1983 to 2000, determination of total uranium supply by portion of production cost, supply and demand are compared for future evolution with different hypothesis.

166 **(IFP—32-603-Pt.2) Balance of the uranium market. Contribution to an economic analysis. Vol. 2.** Ehsani, J. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; Paris-2 Univ., 75 (France)). Nov 1983. 214p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE85752879.

The second volume of this thesis on the economic analysis of the uranium market contains all the technical decriptions concerning reactors and fuel cycle and also detailed results of the two models on uranium supply and demand.

167 **(PNL-SA—13392) Trends of nuclear fuel cycle costs in the United States.** Newman, D.F. (Pacific Northwest Labs., Richland, WA (USA)). Aug 1985. Contract AC06-76RL01830. 7p. (CONF-850931—1). NTIS, PC A02/MF A01. File Number DE85018525.

From International seminar on costs and financing of nuclear power plants in developing countries; Vienna, Austria (9 Sep 1985).

Nuclear fuel cycle costs over the nest 15 years in the US are expected to remain stable or decrease slightly (in constant 1985 dollars) as the gradual rise in price of uranium is offset by reductions in the costs of enrichment. Increased burnup of spent fuel is reducing requirements for fuel fabrication and spent fuel storage, while facilitating increased plant capacity factors through longer fuel cycles. These trends substantiate the competitive position nuclear power is expected to maintain as an economic source of baseloaded electricity generation into the 21st century.

0520 Waste Management

REFER ALSO TO CITATION(S) 207, 208, 210, 211, 213, 214, 215, 217, 220, 221, 222, 225, 229, 906, 908, 992, 993, 1001, 1002, 1054, 1351, 1475, 1476, 1479, 1480, 1491

168 **(AECL—8373-1) Second interim assessment of the Canadian concept for nuclear fuel waste disposal. Volume 1. Summary.** Wuschke, D.M.; Gillespie, P.A.; Main, D.E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jul 1985. 53p. AECL, Chalk River, Ontario, Canada $4.00. File Number TI86900120.

Work performed under Canada/US Waste Management Information Exchange Agreement.

The nuclear fuel waste disposal concept chosen for development and assessment in Canada involves the isolation of corrosion-resistant containers of waste in a vault located deep in plutonic rock. As the concept and the assessment tools are developed, periodic assessments are performed to permit evaluation of the methodology and provide feedstock to those developing the concept. The ultimate goal of these assessments is to predict what impact the disposal system would have on man and the environment if the concept were implemented. This volume briefly describes the Canadian nuclear fuel waste disposal concept, and the methods and results of the second interim pre-closure and post-closure assessments of that concept. 46 refs., 14 figs., 3 tabs.

169 **(AECL—8373-2) Second interim assessment of the Canadian concept for nuclear fuel waste disposal. Volume 2. Background.** Gillespie, P.A.; Wuschke, D.M.; Guvanasen, V.M.; Mehta, K.K.; McConnell, D.B.; Tamm, J.A.; Lyon, R.B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Dec 1984. 77p. AECL, Chalk River, Ontario, Canada $5.00. File Number TI86900121.

Work performed under Canada/US Waste Management Information Exchange Agreement.

The nuclear fuel waste disposal concept chosen for development and assessment in Canada involves the burial of corrosiion-resistant containers of waste in a vault located deep in plutonic rock in the Canadian Shield. As the concept and the assessment tools are developed, periodic assessments are performed to permit evaluation of the methodology and provide feedback to those developing the concept. The ultimate goal of these assessments is to predict what impact the disposal system would have if the concept were implemented. This volume, entitled Background, discusses Canadian nuclear fuel wastes and the desirable features of a waste disposal method. It outlines several disposal options considered by a number of countries, including option chosen for development and assessment in Canada. The reference disposal systems assumed for the second assessment are described, and the approach used for concept assessment is discussed briefly. 79 refs.

170 **(AECL—8373-3) Second interim assessment of the Canadian concept for nuclear fuel waste disposal. Volume 3. Pre-closure assessment.** Johansen, K.; Dunford, W.E.; Donnelly, K.J.; Gee, J.H.; Green, B.J.; Nathwani, J.S.; Quinn, A.M.; Rogers, B.G.; Stevenson, M.A.; Tamm, J.A. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1985. 130p. AECL, Chalk River, Ontario, Canada $5.00. File Number TI86900122.

Work performed under Canada/US Wastes Management Information Exchange Agreement.

The nuclear fuel waste disposal concept chosen for development and assessment in Canada involves the isolation of corrosion-resistant containers of waste in a vault located deep in plutonic rock. As the concept and the assessment tools are developed, periodic assessments are performed to permit evaluation of the methodology and provide feedback to those developing the concept. The ultimate goal of these assessments is to predict what impact the disposal system would have on man and the environment if the concept were implemented. This, the third volume of the report, summarizes the pre-closure environmental safety assessments completed by Ontario Hydro for Atomic Energy of Canada Limited. The preliminary results and their significance are discussed. 85 refs., 9 figs., 26 tabs.

171 **(AECL—8373-4) Second interim assessment of the Canadian concept for nuclear fuel waste disposal. Volume 4. Post-closure assessment.** Wuschke, D.M.; Gillespie, P.A.; Mehta, K.K.; Heinrich, W.F.; LeNeveu, D.M.; Guvanasen, V.M.; Sherman, G.R.; Donahue, D.C.; Goodwin, B.W.; Andres, T.H. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1985. 169p. AECL, Chalk River, Ontario, Canada $9.00. File Number TI86900123.

Work performed under Canada/US Waste Management Information Exchange Agreement.

The nuclear fuel waste disposal concept chosen for development and assessment in Canada involves the isolation of corrosion-resistant containers of waste in a vault located in plutonic rock. As the concept and the assessment tools are developed, perodic assessment are performed to permit evaluation of the methodology and provide feedback to those developing the concept. The ultimate goal of these assessments is to predict what impact the disposal system would have on man and the environment if the concept were implemented. This volume, entitled Post-Closure Assessment, describes the methods, models and data used to perform the second post-closure assessment. The results are presented and their significance is discussed. Conclusions and planned improvements are listed. 72 refs., 32 figs., 28 tabs.

172 **(ANL/EES-TM—290) Radioactive waste isolation in salt: geochemistry of brine in rock salt in temperature gradients and gamma-radiation fields - a selective annotated bibliography.** Hull, A.B.; Williams, L.B. (Argonne National Lab., IL (USA)). Jul 1985. Contract W-31-109-ENG-38. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001935.

Evaluation of the extensive research concerning brine geochemistry and transport is critically important to successful exploitation of a salt formation for isolating high-level radioactive waste. This annotated bibliography has been compiled from documents considered to provide classic background material on the interactions between brine and rock salt, as well as the most important results from more recent research. Each summary elucidates the information or data most pertinent to situations encountered in siting, constructing, and operating a mined repository in salt for high-level radioactive waste. The research topics covered include the basic geology, depositional environment, mineralogy, and structure of evaporite and domal salts, as well as fluid inclusions, brine chemistry, thermal and gamma-radiation effects, radionuclide migration, and thermodynamic properties of salts and brines. 4 figs., 6 tabs.

173 **(BNL-NUREG—30107) Evaluation of backfill as a barrier to radionuclide migration in a high level waste repository.** Ahn, T.M.; Dayal, R.; Wilke, R.J. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 21p. (CONF-810499—2). NTIS, PC A02/MF A01 - GPO. File Number TI86000935.

From National Bureau of Standards workshop of R and D needs in backfill for nuclear waste repositories; Gaithersburg, MD, USA (13 Apr 1981).

The feasibility of using highly sorptive synthetic minerals such as zeolites or titanates as backfill in a HLW repository has been evaluated in terms of the NRC 1000 yr containment and 10^{-5}/yr controlled release criteria. The results indicate that for groundwater velocities below 1 ft/yr, diffusion and sorption are the dominant processes controlling radionuclide migration in backfill systems. A 3-ft-thick bed of synthetic zeolite backfill can provide total containment of activity released continuously from a 55-gallon glass monolith for a period of up to 1000 years. In the absence of the waste form as an engineered barrier, a bed thickness of 3 to 10 ft is required to satisfy the controlled release criterion for a period of up to 10^8 years. With a bed thickness of 200 ft, synthetic zeolites can be used as backfill to provide containment of the total US waste inventory (10^9 Ci), if it were placed in one repository, for periods up to 10^6 years. Zeolites are known to exhibit radionuclide-specific sorption properties. We believe that the range of sorption coefficients (10^3 to 10^4 ml/g) considered in the calculations will cover the various zeolite-radionuclide systems. We wish to emphasize that the above estimates are conservative since diffusion occurs radially and we have only considered uni-dimensional transport in our models. In addition, radioactive decay of the nuclides has not been considered in the calculations. We also wish to note that in this report we have not dealt with radiation and thermal stability of backfill materials. It appears that other materials will have to be added to backfill to maximize its effectiveness for retention of all radionuclides of interest. 23 refs., 3 figs., 7 tabs.

174 **(BNL-NUREG—37068) Potential problem areas: extended storage of low-level radioactive waste.** Siskind, B. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 14p. (CONF-8509121—21). NTIS, PC A02/MF A01 - GPO. File Number TI86001729.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

If a state or regional compact does not have adequate disposal capacity for low-level radioactive waste (LLRW), then extended storage of certain LLRW may be necessary. The Nuclear Regulatory Commission (NRC) has contracted with Brookhaven National Laboratory to address the technical issues of extended storage. The dual objectives of this study are (1) to provide practical technical assessments for NRC to consider in evaluating specific proposals for extended storage and (2) to help ensure adequate consideration by NRC, Agreement States, and licensees of potential problems that may arise from existing or proposed extended storage practices. Storage alternatives are considered in order to characterize the likely storage environments for these wastes. In particular, the range of storage alternatives considered and being implemented by the nuclear power plant utilities is described. The properties of the waste forms and waste containers are discussed. An overview is given of the performance of the waste package and its contents during storage (e.g., radiolytic gas generation, corrosion) and of the effects of extended storage on the performance of the waste package after storage (e.g., radiation-induced embrittlement of polyethylene, the weakening of steel containers by corrosion). Additional information and actions required to address these concerns, including possible mitigative measures, are discussed. 26 refs., 1 tab.

175 **(BNL-NUREG—37070) Treatment of radioactive mixed wastes in commercial low-level wastes.** Kempf, C.R.; MacKenzie, D.R. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 10p. (CONF-8509121—18). NTIS, PC A02/MF A01 - GPO. File Number TI86001731.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

Management options for three generic categories of radioactive mixed waste in commercial low-level wastes have been identi-

fied and evaluated. These wastes were characterized as part of a BNL study in which a large number of generators were surveyed for information on potentially hazardous low-level wastes. The general management targets adopted for mixed wastes are immobilization, destruction, and reclamation. It is possible that these targets may not be practical for some wastes, and for these, goals of stabilization or reduction of hazard are addressed. Solidification, absorption, incineration, acid digestion, segregation, and substitution have been considered for organic liquid wastes. Containment, segregation, and decontamination and re-use have been considered for lead metal wastes which have themselves been contaminated and are not used for purposes of waste disposal shielding, packaging, or containment. For chromium-containing wastes, solidification, incineration, containment, substitution, chemical reduction, and biological removal have been considered. For each of these wastes, the management option evaluation has necessarily included assessment/estimation of the effect of the treatment on both the radiological and potential chemical hazards present. 10 refs.

176 **(CEA-CONF—7814) Nuclear rich alpha cellulosic waste management experiments by acid digestion.** Arnal; Cousinou; Desille; Maigret. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). Mar 1985. 3p. (CONF-850314—75). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752894.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

At Cadarache, where the French plutonium fuel fabrication plant is located, the strategy used for the management of rich alpha waste (superior to accepted level for storage) consists in incinerating the wastes, crushed and washed by cryogenic crushing and soda-nitric solutions. Although all "technological" wastes could be processed this way, the cellulosic are sorted and treated separately by the sulfuric acid digestion process. This process has definite advantages, particularly since it is specific to cellulosis, which dissolves easily at low temperature, i.e., under the boiling point of H_2SO_4. Except for this aspect, of great importance for the gas treatment operations and the resistance of material to corrosion, the process is identical to the one given in the literature: dehydration of cellulosis by H_2SO_4 72% and carbon oxidation by 13N HNO_3. The apparatus used holds a small volume (10 m^3); the glove-box in which the dissolver and the filtration treatments (insoluble Pu sulfate for one part, and reaction gas for the other) are placed is stainless steel coated with corrosion proof paint; the equipments are made of glass (dissolver), teflon (flanges), PVDF (pipes), hastelloy (pompes). A general balance is given for the recuperated nuclear materials, as well as for the mass and volumes of input and output cellulosic wastes.

177 **(CONF-8510169—1) Site characterization investigations at Oak Ridge National Laboratory.** Ketelle, R.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001347.

From Low-level waste siting and characterization meeting; Paris, France (1 Oct 1985).

The geologic and geohydrologic characterization and assessment techniques currently used at ORNL are integrated into a systematic approach. The investigations are multi-faceted, and involve investigators with a variety of expertise. Characterization studies are designed to obtain the data requirements of pathways analysis and facility design in addition to the detailed site description. The approach effectively minimizes the redundancy and lack of coordination which often arise when the study is broken down into totally independent tasks. The geologic environment of the Oak Ridge Reservation is one of structural and stratigraphic complexity which requires a comprehensive and systematic approach to characterize. Recent characterization studies have included state-of-the-science techniques in the areas of unsaturated zone testing, geochemical tests to determine attenuation properties of soils, and numerical analyses of site performance. The results of these studies and analyses are changing the technology of shallow land burial by indicating that chemically stable waste forms are required to limit radionuclide migration to acceptable levels. 11 refs., 1 tab.

178 **(CONF-8510169—2) Systematic approach to geologic and hydrologic site characterization.** Ketelle, R.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001346.

From Low-level waste siting and characterization meeting; Paris, France (1 Oct 1985).

Detailed investigations and analyses are required to define the site characteristics affecting the interactions between the disposal site and its surroundings, the isolation of the wastes, and the long-term stability of the disposal site. These investigations (or site characterization studies) are performed after selection of a preferred site for a low-level waste disposal facility. Site characterization has the specific objectives of providing information needed for: demonstrating that the minimum site conditions used in site selection are met, supporting the performance assessment (pathways analysis), facility design, and preparation of an environmental impact statement, if required. Much of the technical information needed for these specific objectives overlaps. Preliminary information obtained during the site selection activity and the technical considerations generated by the performance objectives are used to plan the scope of site characterization investigations. To provide the necessary data in an efficient and cost-effective manner, site characterization studies should be systematically organized and managed. The investigations should be phased with some flexibility in planning later phases on the basis of findings of preceding studies. A conceptual model of the site and active hydrologic processes should be developed early in site investigations and adjusted as additional detailed data are obtained. The conceptual model is used as the basis on which analytical models used in performance assessment are defined and calibrated.

179 **(DOE/NBM—6001405) Evaluation and review of planning for greater-confinement disposal by the Independent Peer Review Committee, July 9-10, 1985. Final report.** (Argonne National Lab., IL (USA)). Jul 1985. Contract W-31-109-ENG-38. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001405.

This evaluation and review was performed under contract by Argonne National Laboratory in support of their role for developing the "Planning for Greater Confinement Disposal" Document for the Low-Level Waste Management Program Office for the Department of Energy, Office of Defense Waste and Byproducts Management. The Independent Peer Review Committee was composed of 13 well-qualified and recognized experts in their fields and pertinent disciplines, collectively representing considerable expertise and experience in waste disposal operations, waste management, environmental assessment and impact analysis, and other aspects of radioactive waste disposal. The members of the Peer Review Committee, their organizations, and thier area of expertise are given in Appendix 1. The general consensus of the Independent Review Committee was that the "Planning for Greater-Confinement Disposal" document was reasonably comprehensive, covering nearly all topics necessary to provide a good planning guide. There is, however, a definite need to reorganize the document into two volumes with appendices and the relationship of the GCD document to other LLWMP documents needs to be clarified in the introductory volume. Specific recommendations made by the committee on the DCD document are given in Section 3.2. Recommendations by the committee that have a somewhat broader scope than just the GCD document are given in Section 3.3.

180 **(DOE/OR/20722—71) Report on the performance monitoring system for the interim waste containment at the Niagara Falls Storage Site, Lewiston, New York.** (Bechtel National, Inc., Oak Ridge, TN (USA). Advanced Technology Div.). Oct 1985. Contract AC05-81OR20722. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001440.

The Niagara Falls Storage Site (NFSS) is an interim storage site for low-level radioactive waste, established by the US Department of Energy (DOE) at Lewiston, New York. The waste containment structure for encapsulating low-level radioactive waste at the NFSS has been designed to minimize infiltration of rainfall, prevent pollution of groundwater, preclude formation of leachate, and prevent radon emanation. Accurately determining the performance of the main engineered elements of the containment structure will

be important in establishing confidence in the ability of the structure to retain the wastes. For this purpose, a waste containment performance monitoring system has been developed to verify that these elements are functioning as intended. The key objective of the performance monitoring system is the early detection of trends that could be indicative of weaknesses developing in the containment structure so that corrective action can be taken before the integrity of the structure is compromised. Consequently, subsurface as well as surface monitoring techniques will be used. After evaluating several types of subsurface instrumentation, it was determined that vibrating wire pressure transducers, in combination with surface monitoring techniques, would satisfactorily monitor the parameters of concern, such as water accumulation inside the containment facility, waste settlement, and shrinkage of the clay cover. Surface monitoring will consist of topographic surveys based on predetermined gridlines, walkover surveys, and aerial photography to detect vegetative stress or other changes not evident at ground level. This report details the objectives of the performance monitoring system, identifies the elements of the containment design whose performance will be monitored, describes the monitoring system recommended, and outlines the costs associated with the monitoring system. 5 refs., 4 figs., 3 tabs.

181 **(DOE/SR—2001) Defense waste processing facility: an innovative process for high-level waste immobilization.** Cowan, S.P. (USDOE Savannah River Operations Office, Aiken, SC). 1985. 2p. (CONF-850765—40). NTIS, PC A02/MF A01; GPO Dep. File Number DE85018512.

From 26. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (21 Jul 1985).

The Defense Waste Processing Facility (DWPF), under construction at the Department of Energy's Savannah River Plant (SRP), will process defense high-level radioactive waste so that it can be disposed of safely. The DWPF will immobilize the high-activity fraction of the waste in borosilicate glass cast in stainless steel canisters which can be handled, stored, transported and disposed of in a geologic repository. The low-activity fraction of the waste, which represents about 90% of the high-level waste HLW volume, will be decontaminated and disposed of on the SRP site.

182 **(DP-MS—85-58) Decontamination of Savannah River Plant H-Area hot-canyon crane.** Rankin, W.N.; Sims, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Quadrex HPS, Inc., Gainesville, FL (USA)). 1985. Contract AC09-76SR00001. 6p. (CONF-851115—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85018520.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Decontamination techniques applicable to the remotely operated bridge cranes in canyon buildings at the Savannah River Plant (SRP) were identified and were evaluated in laboratory-scale tests. High pressure Freon blasting was found to be the most attractive process available for this application. Strippable coatings were selected as an alternative technique in selected applications. The ability of high pressure Freon blasting plus two strippable coatings (Quadcoat 100 and Alara 1146) to remove the type of contamination expected on SRP cranes was demonstrated in laboratory-scale tests. Quadrex HPS was given a contract to decontaminate the H-Area hot canyon crane. Decontamination operations were successfully carried out within the specified time-frame window. The radiation level goals specified by SRP were met and decontamination was accomplished with 85% less personnel exposure than estimated by SRP before the job started. This reduction is attributed to the increased efficiency of the new decontamination techniques used. 6 refs., 1 tab.

183 **(DPST—80-262) Expected failure frequency of H-canyon and HB-line exhaust fans.** Durant, W.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1 Feb 1980. Contract AC09-76SR00001. 23p. NTIS, PC A02. File Number DE85018517.

The expected frequency of incidents that would disable the entire new H-canyon exhaust fan system while leaving the HB-Line fan system operable is calculated to be once in two thousand failures of the canyon system with a 90% error bound of once in six hundred to once in one hundred thousand canyon system failures. The failure rate of the H-canyon system alone is once in one thousand years with a 90% error bound of once in three hundred years to once in seven thousand years. The corresponding failure rate for the HB-Line system is once in the ten years with a 90% error bound of once in three years to once in one hundred years. Failures in the canyon system that would leave the B-Line system operable are remote because the dominant events of severe natural phenomena and of electrical failures are common to both systems. At least one independent failure, primarily of a mechanical nature, to each of the four canyon fans would have to exist to disable the canyon fans without affecting the B-Line fans.

184 **(EGG—2411) Sizing and melting development activities using contaminated metal at the Waste Experimental Reduction Facility.** Larsen, M.M.; Davis, J.N.; Logan, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1985. Contract AC07-76ID01570. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001945.

EG & G Idaho, Inc., has established the Waste Experimental Reduction Facility (WERF) at the Idaho National Engineering Laboratory (INEL) to develop the capability to reduce the volume that low-level beta/gamma wastes occupy at the disposal site. The work effort at WERF includes a waste sizing development activity (WSDA), a waste melting development activity (WMDA), and a waste incineration development activity (WIDA). This report describes work and developments to date in the sizing and melting activities at WERF involving beta/gamma-contaminated metal.

185 (INIS-mf—9910-Vol.1, pp 69-84) **Engineered facilities for Canada's nuclear fuel waste management program.** Card, E.C. (Wardrop (W.L.) and Associates Ltd., Winnipeg, Manitoba (Canada)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The Canadian nuclear fuel waste management program has the objective to ensure that there will be no significant effects on man or the environment from nuclear fuel wastes at any time. The program encompasses the development of technologies for interim storage and transportation of irradiated fuel, immobilization of fuel wastes and the permanent disposal of immobilized fuel wastes. It is a many-faceted and multi-disciplined undertaking, involving Atomic Energy of Canada Limited, Ontario Hydro, and many other organizations and specialists from both the public and private sectors. Engineered facilities are an integral part of the Canadian waste management program. At present, the need is for experimental installations. Often, these simply provide space for experimental staff and their experiments, along with all required services, equipment and test rigs. At other times, the design and construction of the facilities themselves form part of the experimental program. This paper describes two experimental facilities which W.L. Wardrop and Associates Limited has designed for Atomic Energy of Canada Limited as part of the waste management program: the immobilized fuel test facility and the underground research laboratory.

186 **(KFK—3886) Institut fuer Nukleare Entsorgungstechnik: Status report on research and development 1984.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Feb 1985. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752710.

Some of the main points tackled by the Institute during 1984 included: Testing the glassification technique for radioactive waste and design and construction of a glassification plant; examination of the properties of glass products, testing of incineration of waste containing plutonium; solidification of concentrate containing alpha particles; separation of actinides and fission products from MAW; examination of the release procedures of radio-nuclides from waste solidified with cement; development of long-term containers for the final storage of HAW glass products in salt; model calculations for thermo-mechanical processes and for release mechanisms in final storage.

187 **(KFK—3905) Mathematical modelling of the corrosion and leaching behaviour of cemented waste forms.** Kienzler, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). May 1985. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85752712.

A theoretical model is presented which allows to calculate the leaching of radionuclides and the corrosion of cemented waste forms in contact with water or brine. The model computes both the behaviour of specimens in laboratory-scale experiments and provides a forecast of the behaviour of waste forms in the case of an accidental flooding of a repository. The mathematical formalism employed describes leaching and corrosion on the basis of diffusion and dissolution processes and of chemical reactions. The mathematical formalism is coded in FORTRAN77. This report includes the documentation of the 'DIFMOD' computer code with the associated 'DIFPLO' plot program and the input manual of both programs. Finally application of the model is demonstrated by some examples allowing interpretation of experimental data.

188 **(MLM—3297(OP)) Nitrate waste processing by means of the joule-heated glass furnace.** Armstrong, K.M.; Klingler, L.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1985. Contract AC04-76DP00053. 13p. (CONF-8509121—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001755.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

An investigation was conducted to determine the feasibility of using a joule-heated glass furnace to treat the low-level radioactive nitrate salt wastes being generated in vast quantities at a number of DOE sites. Under current disposal practices, these salts, because of their high solubility, pose a serious threat of groundwater contamination. The goal of the project was to demonstrate thermal decomposition of the salts, without creating an alternate environmental problem by releasing nitrogen oxide gases to the atmosphere. Through the use of literature searches and a series of experimental runs it was found to be possible to obtain both high percentage salt destruction and simple and inexpensive No/sub x/ control. The selective reduction agent, ammonia, introduced under proper furnace conditions, controlled NO/sub x/ emissions to well under 500 ppM without any equipment modifications. 4 figs., 5 tabs.

189 **(MLM—3304) Nitrate waste processing by means of the joule-heated glass furnace.** Armstrong, K.M.; Klingler, L.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 18 Oct 1985. Contract AC04-76DP00053. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002087.

An investigation was conducted to determine the feasibility of using a joule-heated glass furnace to treat the low-level radioactive nitrate salt wastes being generated in vase quantities at a number of DOE sites. Under current disposal practices, these salts, because of their high solubility, pose a serious threat of groundwater contamination. The goal of the project was to demonstrate thermal decomposition of the salts, without creating an alternate environmental problem by releasing nitrogen oxide gases to the atmosphere. Through the use of literature searches and a series of experimental runs it was found to be possible to obtain both high percentage salt destruction and simple and inexpensive NO/sub x/ control. The selective reduction agent, ammonia, introduced under proper furnace conditions, controlled NO/sub x/ emissions to well under 500 ppM without any equipment modifications. 8 refs., 6 figs., 6 tabs.

190 **(NUREG—1046-F) Disposal of high-level radioactive wastes in the unsaturated zone: technical considerations and response to comments. Final report.** Hackbarth, C.J.; Nicholson, T.J.; Evans, D.D. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1985. 47p. NTIS, PC A03/MF A01 - GPO. File Number TI86900170.

On July 22, 1985, the US Nuclear Regulatory Commission (NRC) promulgated amendments to 10 CFR Part 60 concerning disposal of high-level radioactive waste (HLW) in geologic repositories in the unsaturated zone (50 FR 29641). This report contains a discussion of the principal technical issues considered by the NRC staff during the development of these amendments. It expands or revises certain technical discussions originally presented in draft NUREG-1046 (February 1984) based on public comment letters and an increasing understanding of the physical, geochemical, and hydrogeologic processes operative in unsaturated geologic media. The following issues related to disposal of HLW within the unsaturated zone are discussed: hydrogeologic properties and conditions, heat dissipation and temperature, geochemisty, retrievability, potential for exhumation of the radioactive waste by natural causes and by human intrusion, the effects of future climatic changes on the level of the regional water table, and transport of radionuclides in the gaseous state. The changes to 10 CFR Part 60 in definitions, siting criteria, and design criteria for the geologic repository operations area are discussed. Other criteria examined by the NRC staff but which were not changed in rule are the minimum 300-meter depth for waste emplacement, limitations on exploratory boreholes, backfill requirements, waste package design criteria, and provisions for ventilation.

191 **(NUREG/CR—1863) Properties of radioactive wastes and waste containers. Quarterly progress report, July-September 1980.** Morcos, N.; Weiss, A.J. (Brookhaven National Lab., Upton, NY (USA)). Jan 1981. Contract AC02-76CH00016. 110p. (BNL-NUREG—51316). NTIS, PC A06/MF A01 - GPO. File Number TI86000903.

A study was initiated to evaluate the leachability and integrity of bitumen/organic ion exchange resin composites. Mixtures of anionic and cationic resins in the SO_4^{-2}, H^+, Cs^+, and Sr^{+2} forms were used. The leachability of sodium and cesium from the bitumen/organic ion exchange resin composites was observed to increase when anionic resins in the sulfate form were incorporated in the composite. Topical application of a coat of bitumen on these composites decreased Na leachability by sixfold. The leachability of cesium-137 from cement waste forms and cement/organic ion exchange resin (H^+ form) was studied. Portland II and lumnite cements were used in making the forms. Cesium-137 was leached at a faster rate from portland II/ion exchange resin composites that contained the higher ratio of cement to resins, and also from portland II cement waste forms than from that were made with lumnite cement. An experiment was initiated to study the volumetric changes of organic ion exchange resin beds in aquwous media as a function of ionic species and their concentrations in an aqueous milieu. The species studied were cesium, strontium, and aluminum. The resin volumes were observed to decrease when the solute ionic concentration increased, and a hysteresis effect was observed when the solute concentration was then decreased. The resin bed volumes were observed to increase as the solute concentrations decreased, but the resin volumes did not return to their original values. This observed shrinking and swelling is used to explain the disintegration of cement/organic ion exchange resin composites when immersed in water. The paper on "Radiation effects on ion exchangers used in radioactive waste management" in Appendix A has been processed separately for inclusion in the Energy Data Base. 18 refs., 15 figs., 13 tabs.

192 **(NUREG/CR—2123) Identification of processes and parameters of importance to estimation of uncertainties in long-term collective dose and health effects resulting from geologic disposal of high-level radioactive waste.** Triegel, E.K.; Kocher, D.C. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract AC05-84OR21400. 54p. (ORNL/NUREG/TM—456). NTIS, PC A04/MF A01 - GPO. File Number TI86000950.

The purpose of this report is to identify and briefly discuss those processes and parameters which are believed to be important to assessments of the post-closure performance of a geologic repository for high-level radioactive waste. Particular emphasis is given to estimation of uncertainties in the calculation of long-term collective dose and health effects. The discussion is divided into three parts: (1) determination of the critical radionuclides in the waste inventory in terms of potential health detriment to man; (2) identification of processes and parameters of importance to estimating the transport of radionuclides between a repository and the biosphere, based on the assumption that groundwater flow is the mode of transport; and (3) an examination of some critical parameters for es-

timating long-term collective dose and health effects following release of long-lived radionuclides to the biosphere. This report provides an introduction to a more detailed analysis, which is currently being performed, of the uncertainties inherent in estimates of long-time radiological impacts on man resulting from geologic disposal of high-level waste.

193 **(ORNL/TM—9715) Licensing procedures for Low-Level Waste disposal facilities.** Roop, R.D.; Van Dyke, J.W. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001372.

This report describes the procedures applicable to siting and licensing of disposal facilities for low-level radioactive wastes. Primary emphasis is placed on those procedures which are required by regulations, but to the extent possible, non-mandatory activities which will facilitate siting and licensing are also considered. The report provides an overview of how the procedural and technical requirements for a low-level waste (LLW) disposal facility (as defined by the Nuclear Regulatory Commission's Rules 10 CFR Parts 2, 51, and 61) may be integrated with activities to reduce and resolve conflict generated by the proposed siting of a facility. General procedures are described for site screening and selection, site characterization, site evaluation, and preparation of the license application; specific procedures for several individual states are discussed. The report also examines the steps involved in the formal licensing process, including docketing and initial processing, preparation of an environmental impact statement, technical review, hearings, and decisions. It is concluded that development of effective communication between parties in conflict and the utilization of techniques to manage and resolve conflicts represent perhaps the most significant challenge for the people involved in LLW disposal in the next decade. 18 refs., 6 figs.

194 **(ORNL/TM—9756) Extended storage-in-place or MSRE fuel salt and flush salt.** Notz, K.J. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86001720.

The solidified fuel salt and flush salt from the Molten Salt Reactor Experiment (MSRE) have been stored at the Oak Ridge National Laboratory (ORNL) since the reactor was shut down in 1969. The fluoride salt eutectic, containing 37 kg of uranium plus plutonium and fission products, is safely contained in three heavy-walled Hastelloy tanks, which are located inside a reinforced concrete cell. Removal of these salts to a remote location is not feasible until an appropriate repository has been identified, built, and placed in operation. Since this may take many years, extended storage-in-place was critically evaluated. The evaluation, which involved a preliminary assessment of several options for enhancing the integrity of in-place storage, including containment improvements, the addition of chemical getters and neutron poisons, and entombment in concrete, showed that this approach was a rational and safe solution to the problem for the short term. Entombment is essentially nonreversible, but the other options are open-ended; they do not limit the future selection of a final disposal option. Specific actions and improvements that would enhance safe containment during extended storage and would also be of future benefit, regardless of which disposal option is finally selected, were identified. 20 refs., 5 figs., 22 tabs.

195 **(PNL—5578) Lysimeters at the Hanford Site: present use and future needs.** Gee, G.W.; Jones, J.L. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001435.

Lysimeters have been built and used at the Hanford Site for a variety of reasons, including the assessment of recharge (drainage) rates, biointrusion studies, the development of shallow-land burial monitoring and measurement methods, radionuclide transport studies, evapotranspiration studies, and field-scale waste-form leaching tests. A common feature of lysimeters is that they provide a way either to directly measure or to estimate water balance parameters such as soil-water storage changes, evapotranspiration, and drainage for a given site. The number of water balance parameters and the precision with which they can be measured vary depending on the design features of the lysimeter. In this report we describe key design features of the six major lysimeters facilities at Hanford and the types of data available from them. We also address the deficiencies of the present facilities for adequately determining recharge rates and propose additional facilities to evaluate protective barrier systems and arid-land water dynamics. 44 refs., 9 figs., 4 tabs.

196 **(RFP—3837) Plutonium scrap waste processing based on aqueous nitrate and chloride media.** Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 13 May 1985. Contract AC04-76DP03533. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001552.

A brief review of plutonium scrap aqueous waste processing technology at Rocky Flats is given. Nitric acid unit operations include dissolution and leaching, anion exchange purification and precipitation. Chloride waste processing consists of cation exchange and carbonate precipitation. Ferrite and carrier precipitation waste treatment processes are also described. 3 figs.

197 **(RHO-PB-SR—10-B-WM-JUL.85) Defense waste and byproducts management. Monthly report.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jul 1985. Contract AC06-77RL01030. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001136.

Evaporator Run 85-4 continued in July. The monthly evaporator throughput was 2.9 million gallons. The FYTD throughput is 17.6 million gallons, with a waste volume reduction of 5.8 million gallons. The original annual evaporator production goal of 16 million gallons throughput was achieved on July 13. Pumping of liquid from selected single shell tanks and related facilities continued. Approximately 33,000 gallons of liquid was pumped in July. Approximately 414,000 gallons have been pumped FYTD, exceeding the annual plan of 350,000 gallons. The disencapsulation of 155 cesium capsules was completed and the cesium chloride solution was transferred to B Plant for dechlorination. The cesium is being processed to provide 4 MCi of cesium to PNL for the manufacture of radioactive glass canisters for the Federal Republic of Germany. Six casks containing a total of 24 cesium capsules were loaded and shipped to Radiation Sterilizers, Inc. (RSI), following the successful completion of the thermal test. Another three casks were received July 31, and loading efforts were immediately initiated. Cesium capsule shipments to RSI will now proceed at the rate of approximately nine casks per week, depending upon cask arrival at WESF. Core sampling equipment development has been completed. The readiness review process is complete and approval of startup was obtained from the readiness review board. A presentation on Rockwell's efforts to ensure the truck is both safe and operable was made to DOE-RL prior to start-up. The sampling of the first tank, 106-TY, was completed.

198 **(SAND—83-0451) Preliminary report on fluid inclusions from halites in the Castile and lower Salado formations of the Delaware Basin, southeastern New Mexico.** Stein, C.L. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002094.

A suite of samples composed primarily of halite from the upper Castile and lower Salado Formations of the Permian Basin was selected from Waste Isolation Pilot Plant (WIPP) core for a reconnaissance study of fluid inclusions. Volume percent of these trapped fluids averaged 0.7% to 1%. Freezing-point depressions varied widely and appeared to be unrelated to fluid-inclusion type, to sedimentary facies, or to stratigraphic depth. However, because very low freezing points were usually associated with anhydrite, a relation may exist between freezing-point data and lithology. Dissolved sulfate values were constant through the Castile, then decreased markedly with lesser depth in the lower Salado. This trend correlates very well with observed mineralogy and is consistent with an interpretation of the occurrence of secondary polyhalite as a result of gypsum or anhydrite alteration with simultaneous consumption of dissolved sulfate from the coexisting fluids. Together with the abundance and distribution of fluid inclusions in primary or "hopper" crystal structures, this evidence suggests that inclu-

sions seen in these halites did not migrate any significant geographical distance since their formation. 28 refs., 17 figs., 2 tabs.

199 **(SAND—83-1884) Comparative study of radioactive waste emplacement configurations.** Gram, H.F.; Scully, L.W.; Brasier, R.I.; Wheeler, M.L. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos Technical Associates, Inc., NM (USA)). Sep 1985. Contract AC04-76DP00789. 93p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001144.

This study is an evaluation of the self-shielded package and the vertical and horizontal waste emplacement methods. The study suggests a preferred emplacement configuration and identifies the configuration's engineering problems requiring resolution. This study was conducted before September 1983 and used data and assumptions appropriate to that time. Subsequent data may change some results and conclusions in the future. The selection of a preferred waste emplacement method is based on estimates of dependability, safety, and cost effectiveness. The factors evaluated according to these characteristics are the waste package design, analysis of thermal and structural conditions within the repository, emplacement and retrieval operations, repository mining and ventilation, and sealing of the repository. This study indicates that each waste emplacement method has strong points when compared to the others. The three methods differ primarily because of the length and volume of the drifts, heat flow from the waste into open ventilated drifts, the time required for waste emplacement or retrieval, and the extent to which available technology can be applied to the mining and repository operation. Based on this analysis, horizontal emplacement is the preferred method because it requires the least mining, has the lowest ventilation requirements during emplacement and retrieval, and requires the least time for waste emplacement. There are uncertainties associated with horizontal borehole drilling and with the emplacement and retrieval of canisters. Prototype equipment for horizontal drilling, for lining the borehole, and for emplacing and retrieving the waste packages should be developed and tested to resolve these uncertainties.

200 **(SAND—84-1076) Three-dimensional model of reference thermal/mechanical and hydrological stratigraphy at Yucca Mountain, southern Nevada.** Ortiz, T.S.; Williams, R.L.; Nimick, F.B.; Whittet, B.C.; South, D.L. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1985. Contract AC04-76DP00789. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001779.

The Nevada Nuclear Waste Storage Investigations (NNWSI) project is currently examining the feasibility of constructing a nuclear waste repository in the tuffs beneath Yucca Mountain. A three-dimensional model of the thermal/mechanical and hydrological reference stratigraphy at Yucca Mountain has been developed for use in performance assessment and repository design studies involving material properties data. The reference stratigraphy defines units with distinct thermal, physical, mechanical, and hydrological properties. The model is a collection of surface representations, each surface representing the base of a particular unit. The reliability of the model was evaluated by comparing the generated surfaces, existing geologic maps and cross sections, drill hole data, and geologic interpolation. Interpolation of surfaces between drill holes by the model closely matches the existing information. The top of a zone containing prevalent zeolite is defined and superimposed on the reference stratigraphy. Interpretation of the geometric relations between the zeolitic and thermal/mechanical and hydrological surfaces indicates that the zeolitic zone was established before the major portion of local fault displacement took place; however, faulting and zeolitization may have been partly concurrent. The thickness of the proposed repository host rock, the devitrified, relatively lithophysal-poor, moderately to densely welded portion of the Topopah Spring Member of the Paintbrush Tuff, was evaluated and varies from 400 to 800 ft in the repository area. The distance from the repository to groundwater level was estimated to vary from 700 to 1400 ft. 13 figs., 1 tab.

201 **(SAND—85-1776) Application of hydraulic fracturing to determine virgin in situ stress state around Waste Isolation Pilot Plant - in situ measurements.** Wawersik, W.R.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1985. Contract AC04-76DP00789. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86002096.

Hydraulic fracturing tests were carried out in horizontal drillholes in rock salt in the Waste Isolation Pilot Plant (WIPP) near Carlsbad, NM. It was determined that the virgin in situ stress field is isotropic or nearly isotropic. The inferred magnitude of the isotropic in situ stress falls between bounds of 14.28 MPa and 17.9 MPa for the average breakdown/reopening pressures and driving pressures. The best estimate from instantaneous shut-in pressures is 16.61 MPa. Given some uncertainties about the interpretation of hydraulic fracturing data in salt, all of the foregoing values are in acceptable agreement with an average calculated isotropic in situ stress of 14.9 MPa at an average depth of 657 m below surface. Interpretations of breakdown and reopening pressures are based on finite element analyses of the relaxed stress field around a borehole in salt. This stress field varies little between approximately 50 and 200 days after drilling. The finite element analyses were also used to interpret the observed stable pressure-time signatures with little or no pressure drops during primary breakdown of the salt formation. The conclusion about the isotropic nature of the virgin in situ stress field is supported by observations of the induced fracture patterns. The report includes a comparison of the hydrofrac data in the WIPP with the published results of hydraulic fracturing tests in salt at three other locations. 75 refs., 21 figs., 4 tabs.

202 **(SAND—85-7206) WIPP hydrology program Waste Isolation Pilot Plant, SENM. Hydrologic data report No. 1.** (Hydro Geo Chem., Inc., Tucson, AZ (USA)). Sep 1985. Contract AC04-76DP00789. 717p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86001690.

This report, the first of a series of reports, presents the basic data from field investigations to characterize the hydrologic properties of the water-bearing units in the Rustler and overlying formations near the Waste Isolation Pilot Plant, southeastern New Mexico. The field activities have included drilling of new wells and recompletion of existing hydrologic test wells, hydraulic aquifer tests, groundwater tracer tests, and various studies to characterize the regional groundwater flow system. 5 refs., 26 figs., 35 tabs.

203 **(USGS-OFR—85-459) Investigation of an aeromagnetic anomally on west side of Yucca Mountain, Ney County, Nevada.** Bath, G.D.; Jahren, C.E. (Geological Survey, Denver, CO (USA)). 1985. Contract AI08-78ET44802. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85018329.

Investigations of the source of a prominent aeromagnetic anomaly of 290 nT were undertaken at a potential repository site located in the Yucca Mountain area, Nevada Test Site. The anomaly was detected on a recent flight line of a survey flown north-south at 400 m (1300 ft) spacing and 122 m (400 ft) above the surface. The anomaly was not detected on older lines flown east-west at the same spacing and altitude above the surface. The anomaly, which is on the high-standing side of a major fault, was interpreted previously as arising from either an increase of magnetization within a volcanic tuff or a small intrusive feature. Ground magnetic traverses were run to locate the ground maximum, and to delineate anomalies in a traverse that crosses the ground maximum and the nearby fault. Both air and ground anomalies were analyzed using geologic data from surface mapping and drill holes, and magnetic property data from drill holes. The anomaly is caused by contributions from at least three sources. The elevated topography gives a terrain effect since the altitude is decreased between the airplane and exposed Topopah Spring Member of the Paintbrush Tuff. Ground anomalies 300 m (1000 ft) south of the air maximum indicate either an increase in magnetization or the presence of a small intrusive body. Finally, there is an increase in magnetic influence from the nearby Solitario Canyon fault. 16 refs., 10 figs., 5 tabs.

204 **(WIPP-DOE—158) TRU waste certification compliance requirements for remote-handled wastes for shipment to the WIPP.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Sep 1985. Contract AC04-78AL05346. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001150.

Compliance requirements are presented for certifying that unclassified, remote-handled (RH) transuranic (TRU) solid wastes meet the Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC). The requirements apply to both newly generated and TRU wastes retrieved from storage. All applicable DOE orders must continue to be met. The compliance requirements for contact-handled transuranic wastes are addressed in other documents. The compliance requirements are divided into four sections: general requirements, waste container requirements, waste form requirements, and waste package requirements.

205 **Crystalline titanate ceramic nuclear waste forms: processing and microstructure.** Dosch, R.G.; Headley, T.J.; Hlava, P. (Sandia National Laboratories, Albuquerque, New Mexico). *Journal of the American Ceramic Society;* 67: No. 5, 354-361(May 1984).

A process leading to titanate-based crystalline ceramic waste forms for commercial high-level nuclear waste is described. Precursor materials referred to as hydrous calcium titanates are prepared by sol-gel-related techniques. Radionuclides are retained on the precursors by ion-exchange/sorption reactions and the material is converted to a dense, ceramic form by hot-pressing. Transmission electron microscopy-electron microprobe characterization was used to determine the effects of compositional changes and process variations on microstructure.

206 **(NUREG/CR—2193-Vol.1-Nos.3-4) Properties of radioactive wastes and waste containers. Quarterly progress report, October-December 1981.** Morcos, N.; Dayal, R. (Brookhaven National Lab., Upton, NY (USA)). May 1982. Contract AC02-76CH00016. 86p. (BNL-NUREG—51410-Vol.1-Nos.3-4). NTIS, PC A05/MF A01 - GPO. File Number TI86000963.

A study correlating the leachability of ^{137}Cs from small-scale to large-scale cement forms was performed. The waste forms consisted of organic ion exchange resins incorporated in Portland I cement, with a waste-to-cement ratio of 0.6 and a water-to-cement ratio of 0.4 (as free water) and boric acid waste (12% solution), incorporated in Portland III cement, with a waste-to-cement ratio of 0.7. ^{137}Cs was added to both waste types prior to solidification. The samples' dimensions varied from 1 in. x 1 in. to 22 in. x 22 in. (diameter x height) in size. Leach data extending over a period of 260 days were obtained. A method based on semi-infinite plane source diffusion model was applied to analyze the leach data. An effective bulk diffusion coefficient was calculated from the leach data for both types of solidified waste. A derived mathemtical expression allows prediction of the amount of ^{137}Cs leached from the forms as a function of leaching time and waste form dimensions. A reasonably good agreement between the experimental and calculated data is obtained.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 191, 192, 222, 579, 1351

207 **(BNL-NUREG—30099) Trench water-soil chemistry and interactions at the Maxey Flats Site-II.** Weiss, A.J.; Czyscinski, K.S.; Pietrzak, R.F. (Brookhaven National Lab., Upton, NY (USA)). Aug 1981. Contract AC02-76CH00016. 24p. (CONF-810768—1). NTIS, PC A02/MF A01 - GPO. File Number TI86000922.

From NRC program review meeting; Frankfurt, KY, USA (Jul 1981).

The chemistry of leachates in the Maxey Flats trenches is an important factor in evaluating the site's effectiveness for retaining radionuclides. Trench water composition reflects interactions of the buried waste with infiltrating groundwater and the effects of bacterial decomposition of organic material. Aerobic, anaerobic, sulfate reducing, denitrifying and methanogenic bacteria are present in the leachates. Bacterial processes cause decreases in redox potential (Eh), sulfate and nitrate concentrations, as well as increases in alkalinity and ammonia relative to local groundwater compositions. The major radionuclides of concern present in trench waters include: ^{3}H, ^{60}Co, ^{90}Sr, /sup 134, 137/Cs, ^{241}Am, and /sup 238, 239, 240/Pu. Several additional laboratory and field analyses were performed on the fourth sampling of trench waters to better characterize the waters and to assure the reliability of some procedures. New procedures include: sulfide ion measurement in the field; laboratory ion chromatographic determinations of sulfate, chloride, and bromide; Eh and pH measurements in the laboratory; and ferrous-ferric concentration ratios by a colorimetric procedure. No overall systematic change in any disposal trench was observed. Analysis of water collected from the experimental interceptor trenches at Maxey Flats shows a chemical composition intermediate between disposal trench water and local groundwater. The existence of organo-radionuclide complexes that may enhance radionuclide mobility is a subject of much concern in waste management. Low concentrations of free EDTA, NTA, and DTPA are present in some leachates. Sorption experiments demonstrated the ability of EDTA to lower the apparent sorption capacity of Maxey Flats shale. 21 refs., 8 figs., 6 tabs.

208 **(BNL-NUREG—37071) Leaching studies of low-level radioactive waste forms.** Dayal, R.; Arora, H.; Clinton, J.C.; Milian, L. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 14p. (CONF-8509121—17). NTIS, PC A02/MF A01 - GPO. File Number TI86001738.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

A research program has been under way at the Brookhaven National Laboratory to investigate the radionuclide release behavior of ion exchange bead resin waste solidified in Portland cement. An important aspect of this program is to develop and evaluate testing procedures and methodologies which enable the long-term performance evaluation of waste forms under simulated field conditions. Cesium and strontium release behavior using a range of testing procedures, including intermittent leachant flow conditions, has been investigated. For cyclic wet/dry leaching tests, extended dry periods tend to enhance the release of Cs and suppress the release of Sr. Under extended wet period leaching conditions, however, both Cs and Sr exhibit suppressed releases. In contrast, radionuclide releases observed under continuously saturated leaching conditions, as represented by conventional leaching tests, are significantly different. The relevance and aplicability of these laboratory data obtained under a wide range of leaching conditions to the performance evaluation of waste forms under anticipated field conditions is discussed. 12 refs., 9 figs., 3 tabs.

209 (INIS-mf—9758, pp vp) **Radioecological investigation in uranium-rich areas.** Hallstadius, L.; Hedvall, R.; Holm, E.; Pettersson, H. 1984. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85781601. (CONF-8410282—Absts.).

From 7. Nordic Society for Radiation Protection ordinary meeting; Copenhagen, Denmark (10 Oct 1984).

210 **(NUREG/CR—2124) Evaluation of isotope migration: land burial. Quarterly progress report, October-December 1980.** Czyscinski, K.S.; Pietrzak, R.F.; Weiss, A.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1981. Contract AC02-76CH00016. 31p. (BNL-NUREG—51383). NTIS, PC A03/MF A01 - GPO. File Number TI86000949.

Complete results of gamma-ray spectroscopic analysis of the trench 2 core, (recovered from beneath a disposal trench at the Barnwell, South Carolina, disposal facility), showed that the bulk of the ^{60}Co activity (approximately 95%) is confined to the uppermost six segments (approximately 0.5 m of core). Cobalt is the only significant contributor to the gamma activity in core 2. The remaining three cores are devoid of gamma-ray activity above background levels. Results of batch sorption experiments, using sediments and trench waters from the Barnwell facility, showed that steady state behavior is established in an approximate two-month contact time, possibly less. Sorption results plotted as a function of solution/soil ratio show linear behavior for ^{85}Sr, maxima for /sup 134,137/Cs and ^{241}Am, and asymptotic behavior for ^{60}Co. Prediction of column behavior based on batch test results are relatively straight-

forward for ^{85}Sr and ^{60}Co, but not for the isotopes showing maxima. An experimental plan and apparatus is described for use in evaluating the stability of organo-radionuclide complexes under conditions approximating those in disposal trench environments. 23 refs., 16 figs., 3 tabs.

211 **(NUREG/CR—2192-Vol.1) Evaluation of isotope migration - land burial. Volume 1. Quarterly progress report, January-March 1981.** Czyscinski, K.S.; Pietrzak, R.F.; Weiss, A.J. (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 31p. (BNL-NUREG—51409-Vol.1). NTIS, PC A03/MF A01 - GPO. File Number TI86000943.

Results of sorption coefficient determinations (Barnwell, South Carolina, disposal site materials) performed with a recirculating water ("loop") system are compared with batch technique results. Results for cesium and strontium agree within a factor of three; cobalt and europium differ by about one and two orders of magnitude, respectively. Americium results are probably within an order of magnitude, but comparison is difficult to measurement limitations. Additional testing is required to reconile the differences between the two methods. Columns made from repacked material and undisturbed intact sediment showed similar behavior. Single-pass column sorption tests will be performed and compared with batch and "loop" tests in order to formulate general testing guidelines. Results of radiostrontium and plutonium analyses for Barnwell, South Carolina, disposal trench waters (collected 5/80) are similar to concentrations found in previously sampled trench waters. Gross alpha-beta activity of cores from beneath disposal trenches at Barnwell, South Carolina, showed activity above background (uncontaminated local soils) only in the uppermost portion (0.25 meters) of one of the four cores taken (core two). Analyses for radiostontium and plutonium are in progress. The pH of trench waters having undergone complete oxidation varied between 6 to 8. Waters showing changes significantly outside this range are atypical of normal disposal trench situations. Laboratory controlled environment stability studies of Co-EDTA and Co-NTA complexes in strongly reducing, anoxic water regimes showed these complexes to be stable over the duration of the experiments.

212 **(NUREG/CR—2286) Environment in the vicinity of Uravan mill: characterization of radioactive effluents and airborne radionuclide concentrations.** Momeni, M.H. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 63p. NTIS, PC A04/MF A01 - GPO. File Number TI86000966.

A short-term study was conducted at the Uravan uranium mill of Union Carbide Corporation during November-December 1977 to characterize the principal sources of radioactive emissions and to measure the airborne particulate concentrations of U-238, Th-230, Ra-226, Pb-210, and Rn-222 and its daughters in working-level units. The average specific activity of the throughput for the two months was 470 pCi/g for each radionuclide, indicating secular radioactive equilibrium. The average specific activities of the two-month samples of the solid tailings were 1160 pCi/g for Ra-226, 1210 pCi/g for Pb-210, 90.3 pCi/g for U-238 and 533 pCi/g for Th-230. The concentrations of the soluble radionuclides in water from the nearby San Miguel River suggest possible contamination of the river by the mill tailings. We measured the size distribution of airborne particle at several locations and determined the specific activity of U-238, Th-230, Ra-226, and Pb-210 as a function of particle size. We also simulated the dispersion of airborne effluents at sunrise and sunset, both on the mesa and within the canyon. The results indicate the probable trapping at night of the effluents release within the canyon. They also indicate accumulation in the canyon of radon gas released from the tailings deposited on the mesa. 20 refs., 40 figs., 15 tabs.

213 **(NUREG/CR—2616) Evaluation of isotope migration - land burial. Water chemistry at commercially operated low-level radioactive waste disposal sites. Status report, October 1980-September 1981.** Pietrzak, R.; Czyscinski, K.S.; Weiss, A.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1982. Contract AC02-76CH00016. 89p. (BNL-NUREG—51514). NTIS, PC A05/MF A01 - GPO. File Number TI86000962.

The prime consideration for continued use of shallow land burial practices for the disposal of low-level radioactive waste is the containment of radionuclides. Before additional disposal sites for commercial low-level waste can be licensed, the existing sites must be evaluated in terms of their effectiveness for retaining radionuclides. This study is an attempt to monitor the behavior of existing low-level disposal sites, provide an understanding of significant factors which affect prediction of radionuclide movement along the groundwater flow paths, and assist in the development of criteria for the selection and licensing of future low-level disposal sites. Brookhaven National Laboratory (BNL) began a field and laboratory testing program in 1976 sponsored by the US Nuclear Regulatory Commission (USNRC), in cooperation with the US Geological Survey (USGS), to study the existing commercial low-level radioactive waste disposal sites. This investigation measures the source terms (concentrations in solution) of radionuclides and other solutes in the disposal trench waters, and describes the physical and chemical properties of the site geochemistry that control the movement of radionuclides. 49 refs., 27 figs., 23 tabs.

214 **(NUREG/CR—2617) Properties of radioactive wastes and waste containers. Status report, October 1980-September 1981.** Morcos, N.; Dayal, R.; Weiss, A.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1982. Contract AC02-76CH00016. 186p. (BNL-NUREG—51515). NTIS, PC A09/MF A01 - GPO. File Number TI86000977.

Licensing of near surface low-level radioactive waste disposal sites and waste forms/containers requires the ability to predict the dispersibility of radionuclides from waste forms and waste containers disposed in burial sites. Basic concerns in licensing radioactive waste forms and containers are their dimensional stability and the potential for migration of the radionuclides enclosed therein in a near- and long-term predictable fashion. To assess these concerns, a data base is needed for evaluating the acceptability of solidified low-level radioactive waste packages for disposal. Furthermore, the need to develop test procedures and methodologies exists to enable the prediction of long-term performance of waste forms based on short-term laboratory tests. The objectives of the research program at BNL are to provide an improved understanding of phenomena, testing methodology and data. This improves the NRC's capability to predict low-level waste isolation performance, and to provide a better technical basis for regulatory standards. The areas addressed to meet these objectives during the 1981 fiscal year were: leachability and compressive strength of boric acid waste in Portland III cement. The tracers used for the study were ^{137}Cs, ^{85}Sr, and ^{60}Co; leachability of ^{137}Cs, ^{85}Sr, and ^{60}Co from organic ion exchange resin/Portland III and Lumnite cements; displacement of ^{137}Cs, ^{85}Sr, and ^{60}Co from organic ion exchange resins upon mixing with Portland II and Lumnite cements; leachability of organic ion exchange resins/Bitumen composites using resins in the H^+, Na^+, Cs^+, Sr^{+2}, and SO_4^{-2} forms, and ^{137}Cs and ^{85}Sr tracers; correlation of ^{137}Cs leachability from small-scale (laboratory) samples to large-scale waste forms; and hydrostatic testing of DOT 17H drums. 32 refs., 61 figs., 33 tabs.

215 **(ORNL/TM—9467) Application of the finite element groundwater model FEWA to the engineered test facility.** Craig, P.M.; Davis, E.C. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001424.

A finite element model for water transport through porous media (FEWA) has been applied to the unconfined aquifer at the Oak Ridge National Laboratory Solid Waste Storage Area 6 Engineered Test Facility (ETF). The model was developed in 1983 as part of the Shallow Land Burial Technology - Humid Task (ONL-WL14) and was previously verified using several general hydrologic problems for which an analytic solution exists. Model application and calibration, as described in this report, consisted of modeling the ETF water table for three specialized cases: a one-dimensional steady-state simulation, a one-dimensional transient simulation, and a two-dimensional transient simulation. In the one-dimensional steady-state simulation, the FEWA output accurately predicted the water table during a long period in which there were no man-induced or natural perturbations to the system. The input parameters of most importance for this case were hydraulic conductivity and aquifer bottom elevation. In the two transient cases, the FEWA

output has matched observed water table responses to a single rainfall event occurring in February 1983, yielding a calibrated finite element model that is useful for further study of additional precipitation events as well as contaminant transport at the experimental site.

216 **(PB—85-221380/XAB) Health hazard evaluation report HETA 82-361-1437, Kerr-McGee Nuclear Corporation, Grants, New Mexico.** Ward, E.M.; Smith, A.B.; Thun, M.J.; Hills, B. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1984. 37p. (HETA—82-361-1437). NTIS, PC A03/MF A01.

A health-hazard evaluation at Kerr/McGee Nuclear Corporation's uranium (7440611) mill (SIC-1094) in Grants, New Mexico was conducted in November, 1982. Evaluation was requested because of union concern about exposure and possible nephrotoxic effects of yellowcake, a concentrate of natural uranium, produced at the mill. Personnel records, company environmental and personal monitoring, and urine uranium bioassay data were reviewed. Further medical evaluation at the facility is not warranted as the longest exposure to yellowcake was only 7 years. The authors recommend that Kerr/McGee use the NRC guidelines for assessing exposure. Emission source in the drier and precipitation area should be identified and engineering controls installed to reduce the exposure.

217 **(PNL-SA—13375) Radionuclide migration in groundwater at a low-level waste disposal site: a comparison of predictive performance modeling versus field observations.** Robertson, D.E. Myers, D.A.; Bergeron, M.P.; Champ, D.R.; Killey, R.W.D.; Moltyaner, G.L.; Young, J.L. (Pacific Northwest Labs., Richland, WA (USA); Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1985. Contract AC06-76RL01830. 20p. (CONF-8509121—12). NTIS, PC A02/MF A01 - GPO. File Number TI85018523.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

This paper describes a project which is structured to test the concept of modeling a shallow land low-level waste burial site. The project involves a comparison of the actual observed radionuclide migration in groundwaters at a 30-year-old well-monitored field site with the results of predictive transport modeling. The comparison is being conducted as a cooperative program with the Atomic Energy of Canada Ltd. (AECL) at the low-level waste management area at the Chalk River Nuclear Laboratories, Ontario, Canada. A joint PNL-AECL field inviestigation was conducted in 1983 and 1984 to complement the existing extensive data base on actual radionuclide migration. Predictive transport modeling is currently being conducted for this site; first, as if it were a new location being considered for a low-level waste shallow-land burial site and only minimal information about the site were available, and second, utilizing the extensive data base available for the site. The modeling results will then be compared with the empirical observations to provide insight into the level of effort needed to reasonably predict the spacial and temporal movement of radionuclides in the groundwater enviroment. 8 refs., 5 figs.,

218 **(USGS-OFR—84-627) Stability of slopes below the Sherwood Uranium Mine, Spokane Indian Reservation, Northeastern Washington.** Chleborad, A.F.; Schuster, R.L. (Geological Survey, Reston, VA (USA)). 1984. 61p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900030.

The open-pit Sherwood Uranium Mine is within the Spokane Indian Reservation, in Stevens County, northeastern Washington. It is approximately 35 mi northwest of the city of Spokane. The mine overlooks the Spokane River Arm of Franklin D. Roosevelt Lake from a ridge some 600 ft above the lake. Spoil piles as high as 90 ft extend for over a mile along the ridge in northwesterly and southeasterly directions from the mine workings. The purpose and scope of this study are to evaluate the stability of slopes bordering Franklin D. Roosevelt Lake at the Sherwood Mine site, and to make appropriate recommendations for mitigating or preventing possible slope failures. To achieve this, a review has been made of pertinent geologic literature dealing with the Spokane River Arm and surrounding regions. Surface geologic investigations included outcrop and stratigraphic studies, field mapping, and outcrop sampling. Geologic experts were consulted on the surficial geology and on regional landsliding, and air photo interpretations of the geology were made using 1:9000-scale, color air photos. Subsurface investigations were accomplished by drilling and by seismic refraction. Conventional limit-equilibrium stability analyses were used to evaluate slope stability for a wide variety of trial failure surfaces. 34 refs., 22 figs., 7 tabs.

0540 Health And Safety

REFER ALSO TO CITATION(S) 192, 772, 1246, 1323, 1449

219 **(ANL-OHS/HP—85-102) Radiological assessment report for the Lansdowne property, 105-107 East Stratford Avenue, Lansdowne, Pennsylvania, October-December 1984.** Wynveen, R.A.; Smith, W.H.; Sholeen, C.M.; Flynn, K.F. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 148p. NTIS, PC A07/MF A01; GPO Dep. File Number DE86001477.

Areas with elevated levels of radioactivity were found throughout both residences, as well as on the surrounding property. Contamination was also found in the garage behind the 105 East structure. The 105 East residence had substantially more contamination than the 107 East residence, as was expected. The chimneys, particularly the rear chimney, from the 105 East residence had extensive contamination, indicating that contaminated materials may have been burned at the site. The high background radiation emanating from this residence made it difficult to establish the relatively lower levels of contamination in the 107 East residence. The property surrounding the 105 East residence was found to have substantial contamination scattered throughout, with the highest level occurring in the backyard. The soil surface contamination seemed to drop markedly (but not entirely) at the property lines. The property surrounding 107 East was found to be less contaminated, although the background radiation emanating from the adjoining area made it difficult to establish the degree of surface or near-surface contamination from surface surveys. Subsurface investigation of the soil surrounding the structure indicated that radium contamination was widespread and extended to a depth of eight feet at some locations. There was evidence that some of this contamination extended onto adjoining properties and may have been transported off the site via subsurface migration. Additionally, analysis of samples from access points in the residence sewer system effluent established that the system was contaminated. 3 refs., 26 figs., 13 tabs.

220 **(DOE/EIS—0099-F-Vol.1) Remedial actions at the former Vitro Chemical Company site, South Salt Lake, Salt Lake County, Utah. Volume I. Text. Final Environmental Impact Statement.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Jul 1984. 395p. NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE85018030.

This statement evaluates the environmental impacts associated with the cleanup of those residues remaining at the abandoned uranium-mill-tailings site located in South Salt Lake, Utah, and hereinafter called the Vitro site. The site is a 128-acre property owned by the Central Valley Water Reclamation Facility (CVWRP) Board which also operates a sewage treatment plant adjacent to the northern boundaries of the Vitro site. The site contains approximately 2.5 million cubic yards of contaminated residues and soil; the residues were produced by the Vitro Chemical Company of America which processed uranium ore for sale to the US Atomic Energy Commission on the site from 1951 to 1964. This statement evaluates three alternatives for minimizing the public health hazards associated with the Vitro site contaminated materials: (1) no action; (2) stabilization of the contaminated material on the Vitro site; and (3) decontamination of the Vitro site and disposal of the contaminated material at a site located about one mile south of Clive, Utah. Alternative 3 is DOE's preferred alternative. An assessment of the impacts of these three alternatives was made in terms of effects on radiation levels, air quality, soils and mineral resources, surface- and ground-water resources, ecosystems, land

use, sound levels, historical and cultural resources, populations and employment, economic structures, and transportation networks.

221 **(DOE/EIS—0099-F-Vol.2) Remedial actions at the former Vitro Chemical Company site, South Salt Lake, Salt Lake County, Utah. Volume II. Appendices. Final Environmental Impact Statement.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Jul 1984. 471p. NTIS, PC A20/MF AA01; 1; GPO Dep. File Number DE85018031.

This appendix provides the information needed to understand the conceptual designs for the remedial action alternatives addressed in this Final Environmental Impact Statement. This appendix is intended to provide sufficient detail for the reader to understand the remedial action alternatives and the anticipated environmental impacts. This appendix is not intended to provide the detailed engineering necessary to implement the alternatives.

222 **(DOE/OR/20722—70) Radiological survey report for the Weldon Spring Quarry.** (Bechtel National, Inc., Oak Ridge, TN (USA). Advanced Technology Div.). Sep 1985. Contract AC05-81OR20722. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001223.

The Weldon Spring Site (WSS) is a US Department of Energy surplus facility comprising the Quarry, Raffinate Pits, Chemical Plant, and vicinity properties. Radiological characterization of the WSS is being conducted in four phases: the Raffinate Pits facility, Quarry, Chemical Plant, and the vicinity properties. Bechtel National, Inc. and its radiological support contractor, Eberline Analytical Corporation, conducted a radiological characterization survey of the Raffinate Pits in 1982 and 1983; the survey of the Quarry described in this document represents the second phase of the work and was performed in 1984 and 1985. The survey consisted of direct beta-gamma surface readings, near-surface gamma readings, exposure level measurements, radon emission rate measurements, and gamma logs of boreholes. Samples of surface soils, subsurface soils, surface water, and groundwater were collected. These samples were analyzed for selected radionuclides in the uranium and thorium natural decay chains. This report describes the radiological and chemical characterization of the Quarry, the procedures used to conduct the survey, and the survey results. Estimates based on the radiological data indicate that 95,000 yd^3 of surface and subsurface materials at the Quarry are contaminated in excess of DOE guidelines; concentrations of radionuclides in sediment from the Quarry pond were approximately 100 times background. Soil samples were not hazardous as defined by the Resource Conservation and Recovery Act, but varying concentrations were found of chemicals classified as priority pollutants by the Environmental Protection Agency. Concentrations of uranium in groundwater exceeded DOE guidelines; however composites of water from the Quarry pond showed uranium concentrations only slightly in excess of the guideline. 15 refs., 14 figs., 8 tabs.

223 **(INIS-mf—9904) Leukaemia in East Suffolk.** Bush, M.F.H. (East Suffolk Health Authority (UK)). Sep 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86780030.

An investigation was conducted by the East Suffolk Health Authority to determine whether there were any geographical variations in the incidence of leukaemia over the last fifteen years in East Suffolk suggesting an environmental hazard, e.g. Sizewell Power Station. No areas were found to have a statistically significant increased incidence of leukaemia cases although there did appear to be a cluster of cases in the Leiston area. (U.K.).

224 **(NUREG/CR—4321) Full-scale measurements of smoke transport and deposition in ventilation system ductwork.** Martin, R.A.; Fenton, D.L. (Los Alamos National Lab., NM (USA)). Jul 1985. Contract W-7405-ENG-36. 39p. (LA—10478-MS). NTIS, PC A03/MF A01 - GPO. File Number TI85017973.

This study is part of an effort to obtain experimental data in support of the fire accident analysis computer code FIRAC, which was developed at the Los Alamos National Laboratory. FIRAC can predict the transient movement of aerosolized or gaseous material throughout the complex ventilation systems of nuclear fuel cycle facilities. We conducted a preliminary set of full-scale material depletion/modification experiments to help assess the accuracy of the code's aerosol depletion model. Such tests were performed under realistic conditions using real combustion products in full-sized ducts at typical airflow rates. To produce a combustion aerosol, we burned both polystyrene and polymethyl methacrylate, the most and least smoky fuels typically found in fuel cycle plants, under varied ventilation (oxygen-lean and oxygen-rich) conditions. Aerosol mass deposition, size, and concentration measurements were performed. We found that as much as ~25% of polystyrene smoke mass and as little as 2% of the polymethyl methacrylate generated at the entrance to a 15.2-m duct is deposited on the duct walls. We also compared our experimental results with theoretical equations currently used in FIRAC. 28 refs., 8 figs., 5 tabs.

225 **(SAND—85-7157) Preliminary NEA dump site safety analysis.** Scott, J.I.; Ensminger, D.A.; Koplik, C.M. (Analytic Sciences Corp., Reading, MA (USA)). Sep 1985. Contract AC04-76DP00789. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001746.

A preliminary safety analysis of the NEA low-level radioactive dump site in the Northeast Atlantic is presented. Projected releases from the site and resultant concentrations in the ocean waters and sediment are calculated. The estimated doses to individuals from critical pathways are 3 to 4 orders of magnitude below natural background levels. These results are modeland data-dependent, and should be considered as very preliminary. 13 figs., 33 tabs.

0550 Regulations

REFER ALSO TO CITATION(S) 149, 150, 1356

226 **(BNL—51450-2nd-Ed.) Safeguards instrumentation: a computer-based catalog. Second edition.** Auerbach, C. (Brookhaven National Lab., Upton, NY (USA)). Apr 1985. Contract AC02-76CH00016. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86000840.

This catalog contains entries on new developments and on items listed in BNL 51450, which have either been carried over unchanged or been updated. More than 70 entries were deleted because of either obsolescence, insufficient interest in terms of safeguards, or lack of documentable development activities in recent years. Some old listings as well as new material was consolidated into more generic entries. As in the earlier document, the emphasis is on devices and instruments that are either in field use at this time or under active development. A few items such as NDA reference materials, instrument vans and certain shipping containers are included because they are important adjuncts to optimum utilization of safeguards instrumentation. This catalog does not include devices for physical protection. As was the case with its predecessor, most of the material in this catalog originated in the US and Canada; a few contributions came from member states of the European Community.

227 **(BNL-NUREG—27953) Updated inventory of existing and projected SNM in the US nuclear power industry.** Indusi, J.P. (Brookhaven National Lab., Upton, NY (USA)). Jun 1980. Contract AC02-76CH00016. 8p. (CONF-800655—39). NTIS, PC A02/MF A01 - GPO. File Number TI86000176.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

The existing and projected inventory of special nuclear material (SNM) in the US nuclear power industry helps to place the safeguards problem in perspective. The quantities of SNM generated by power reactors are primarily dependent upon the forecast of nuclear generating capacity. Ten nuclear generating capacity projections, developed from 1972 to 1979, are presented and discussed. Finally, the most reasonable projection is used to derive the projected inventory of SNM to the year 2000.

228 **(BNL-NUREG—28003) Guidelines for preparing IAEA Design Information Questionnaires.** Swartz, J.M.; Bieber, A.M. (Science Applications International Corp., La Jolla, CA (USA); Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 5p. (CONF-800655—40). NTIS, PC A02/MF A01 - GPO. File Number TI86000126.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

SAI under contract to BNL/TSO has developed guidelines for the preparation of IAEA Design Information Questionnaires (DIQs) for use by US nuclear facilities that will be subject to international safeguards. These guidelines give an explanation of what information the IAEA is requesting, a statement of the use to which the IAEA will direct the information, and a model format that the response should take. Separate guidelines have been prepared for DIQs on power and research reactors, conversion and/or fuel fabrication plants, reprocessing plants, critical or sub-critical facilities, and separate storage facilities. As well as a technical working tool, the guidelines also provide the facility operator with sufficient information to estimate the level of effort required to complete the DIQ.

229 **(BNL-NUREG—37007) Application of EPA regulations to low-level radioactive waste.** Bowerman, B.S.; Piciulo, P.L. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-8506200—1). NTIS, PC A02/MF A01 - GPO. File Number TI86001201.

From 10. campus radiation safety officers biennial conference; Ithaca, NY, USA (25 Jun 1985).

The survey reported here was conducted with the intent of identifying categories of low-level radioactive wastes which would be classified under EPA regulations 40 CFR Part 261 as hazardous due to the chemical properties of the waste. Three waste types are identified under these criteria as potential radioactive mixed wastes: wastes containing organic liquids; wastes containing lead metal; and wastes containing chromium. The survey also indicated that certain wastes, specific to particular generators, may also be radioactive mixed wastes. Ultimately, the responsibility for determining whether a facility's wastes are mixed wastes rest with the generator. However, the uncertainties as to which regulations are applicable, and the fact that no legal definition of mixed wastes exists, make such a determination difficult. In addition to identifying mixed wastes, appropriate methods for the management of mixed wastes must be defined. In an ongoing study, BNL is evaluating options for the management of mixed wastes. These options will include segregation, substitution, and treatments to reduce or eliminate chemical hazards associated with the wastes listed above. The impacts of the EPA regulations governing hazardous wastes on radioactive mixed waste cannot be assessed in detail until the applicability of these regulations is agreed upon. This issue is still being discussed by EPA and NRC and should be resolved in the near future. Areas of waste management which may affect generators of mixed wastes include: monitoring/tracking of wastes before shipment; chemical testing of wastes; permits for treatment of storage of wastes; and additional packaging requirements. 3 refs., 1 fig., 2 tabs.

230 **(DOE/DP—0001/16) Strategic special nuclear material Inventory Differences. Semiannual report, April 1-September 30, 1984.** (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of Safeguards and Security). Jul 1985. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86000051.

This sixteenth periodic semiannual report of Inventory Differences (ID) covers the last six months of fiscal year 1984 (April 1, 1984, through September 30, 1984), for the Department of Energy (DOE) and DOE contractor facilities possessing significant quantities of strategic special nuclear material (SSNM). Inventory Differences are simply the differences between the amount of material shown in the accounting records and the amount of material reported in the physical inventory. These differences are generally due to errors in estimating material in unmeasurable form at the time of an inventory, unmeasurable holdup in equipment, measurement imprecisions, inaccuracies in initial determinations of SSNM produced or used in nuclear reactors, and inventory or bookkeeping errors. Both DOE and contractors operating DOE facilities carefully maintain, analyze, and investigate ID data. Inventory Differences are expected in nuclear material processing and are not, in and of themselves, evidence of lost or stolen material. On the other hand, ID analysis provides valuable information on the effectiveness of the safeguards system's physical protection and material control measures as well as a check on the process controls and material management procedures. ID's outside safeguards control limits or involving a missing SSNM discrete item are investigated. If necessary, an operation may be shut down until an ID is resolved.

231 **(KFK—3935) Test procedures to detect a loss of material in a sequence of balance periods.** Avenhaus, R.; Beedgen, R.; Sellinschegg, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Jun 1985. 91p. (PWA—16/85). NTIS (US Sales Only), PC A05/MF A01. File Number DE85752714.

A workshop on Near-Real-Time Accountancy (NRTA) was held in KfK which came to a preliminary end in December 1982. In the framework of this workshop a number of sequential statistical test procedures were proposed which can be used in the case of a NRTA based safeguards regime. In the report the most promising test procedures are investigated. The analysis is based on the chemical separation process of a large model reprocessing facility with a throughput or 1000 tonnes per year.

232 **(LA—10510-M) Uranium concentration monitor manual, secondary intermediate evaporator.** Russo, P.A.; Sprinkle, J.K. Jr.; Slice, R.W.; Strittmatter, R.B. (Los Alamos National Lab., NM (USA)). Aug 1985. Contract W-7405-ENG-36. 108p. (Y/DG—17232). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001232.

This manual describes the design, operation, and measurement control procedures for the automated uranium concentration monitor on the secondary intermediate evaporator at the Oak Ridge Y-12 Plant. The nonintrusive monitor provides a near-real time readout of uranium concentration in the return loop of time recirculating evaporator for purposes of process monitoring and control. A detector installed near the bottom of the return loop is used to acquire spectra of gamma rays from the evaporator solutions during operation. Pulse height analysis of each spectrum gives the information required to deduce the concentration of uranium in the evaporator solution in near-real time. The visual readout of concentration is updated at the end of every assay cycle. The readout includes an alphanumeric display of uranium concentration and an illuminated, colored LED (in an array of colored LEDs) indicating whether the measured concentration is within (or above or below) the desired range. An alphanumeric display of evaporator solution acid molarity is also available to the operator. 9 refs., 16 figs., 4 tabs.

233 **(NUREG—0525-Rev.1) Safeguards Summary Event List (SSEL). Pre-NRC through June 30, 1979.** Davidson, J.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards). Nov 1979. 146p. NTIS, PC A07/MF A01 - GPO. File Number TI86900078.

Nine categories of events involving NRC licensed material or licensees are included. As additional information is obtained on an event, it will be incorporated in future editions. The list contains incidents as well as less significant events. The nine categories are: bomb-related (divided into two sections: (1) those events in which a bomb or explosive material was located or an explosion occurred at or in the vicinity of a licensed facility, and (2) a complete chronological list), intrusion, missing and/or allegedly stolen, transportation-related, vandalism, arson, firearms-related, sabotage, and miscellaneous.

234 **(NUREG/CR—0849-Vol.2-No.4) Safeguards material control and accounting program. Volume 2, No. 4. Quarterly report, October-December 1980.** Poggio, A.J.; Dunn, D.R. (Lawrence Livermore National Lab., CA (USA)). Oct 1981. Contract W-7405-ENG-48. 26p. (UCRL—52715-81-1). NTIS, PC A03/MF A01 - GPO. File Number TI86000967.

This report summarizes the October-December activities of the Safeguards Material Control and Accounting Program sponsored by the US Nuclear Regulatory Commission (NRC) at the Lawrence Livermore National Laboratory (LLNL). It describes our progress in applying and developing computer-based methodologies for assessing the vulnerabilities of material control and accounting (MC and A) systems in nuclear fuel-cycle facilities. This report also identifies deterministic checks and balances which could be applied by the NRC interfacility material accounting system for detecting and deterring both material diversion and material accounting data falsification.

235 **(NUREG/CR—0849-Vol.3-No.1) Safeguards Material Control and Accounting Program. Quarterly report, January-March 1981. Volume 3, No. 1.** Poggio, A.J.; Dunn, D.R. (Lawrence Livermore National Lab., CA (USA)). Oct 1981. Contract W-7405-ENG-48. 10p. (UCRL—52715-81-2). NTIS, PC A02/MF A01 - GPO. File Number TI86000182.

This report summarizes the January-March activities of the Safeguards Material Control and Accounting Program sponsored by the US Nuclear Regulatory Commission at the Lawrence Livermore National Laboratory. It describes work in progress with respect to computer-based methodologies for assessing the vulnerabilities of material control and accounting systems in nuclear fuel-cycle facilities.

236 **(NUREG/CR—0975) Nondestructive assay confirmatory assessment experiments: mixed oxide.** Lemming, J.F. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 30 Apr 1980. Contract AC04-76DP00053. 44p. (MLM—2695). NTIS, PC A03/MF A01. File Number TI86000098.

The confirmatory assessment experiments demonstrate traceable nondestructive assay (NDA) measurements of plutonium in mixed oxide powder using commercially available spontaneous-fission assay systems. The experiments illustrate two major concepts: the production of calibration materials using calorimetric assay, and the use of paired measurements for measurement assurance. Two batches of well-characterized mixed oxide powder were used to establish the random and systematic error components. The major components of an NDA measurement assurance technique to establish and maintain traceability are identified and their functions are demonstrated. 20 refs., 10 figs., 10 tabs.

237 **(NUREG/CR—1048) Technical safeguards issues for alternative fuel cycles.** Weinstock, E.V.; Keisch, B. (Brookhaven National Lab., Upton, NY (USA)). 3 Jan 1980. Contract AC02-76CH00016. 230p. (BNL-NUREG—51182). NTIS, PC A11/MF A01 - GPO. File Number TI86000125.

This report identifies and, to the extent possible with the limited time and resources allotted to the project, assesses technical safeguards issues associated with the proposed alternative fuel cycles, so that their impact on safeguards regulation can be judged. The 21 fuel cycles considered are a slightly expanded version of the set submitted by DOE to NRC in attachments to letters from E.J. Hanrahan of DOE to N. Haller of NRC, dated August 7 and September 1, 1978 and February 13, 1979.

238 **(NUREG/CR—1233-Vol.3) Structured assessment approach: Version I. Applied demonstration of output results. Volume 3.** Parziale, A.A.; Sacks, I.J. (Lawrence Livermore National Lab., CA (USA)). Oct 1979. Contract W-7405-ENG-48. 350p. (UCRL—52735-Vol.3). NTIS, PC A15/MF A01 - GPO. File Number TI86000137.

A methodology, the Structured Assessment Approach, has been developed for the assessment of the effectiveness of material control and accounting (MC and A) safeguards systems at nuclear fuel cycle facilities. This methodology has been refined into a computational tool, the SAA Version 1 computational package, that was used first to analyze a hypothetical fuel cycle facility (HFCF) and used more recently to assess operational nuclear plants. The Version 1 analysis package is designed to analyze safeguards systems that prevent the diversion of special nuclear material (SNM) from nuclear fuel cycle facilities and to provide assurance that diversion has not occurred. This report is the third volume, Applied Demonstration of Output Results, of a four-volume document. It presents the outputs for each of the four levels of the SAA Version 1 computational package. Two types of outputs are discussed: detailed output findings and summary output tables. The summary output tables are used to aggregate the detailed output findings in a condensed form for NRC analyst consumption. Specific output results are presented for an HFCF, which is described in Volume II.

239 **(NUREG/CR—1233-Vol.4) Computational analysis package: the structured assessment approach, Version I. Volume 4.** Parziale, A.A.; Patenaude, C.J.; Renard, P.A.; Freeman, D.W.; Ross, D.J.; Sacks, I.J. (Lawrence Livermore National Lab., CA (USA)). 1979. Contract W-7405-ENG-48. 143p. (UCID—18146). NTIS, PC E06/MF A01 - GPO. File Number TI86000936.

Includes 3 sheets of 24x reduction microfiche.

A methodology, called the Structured Assessment Approach (SAA), has been developed to assess the effectiveness of material control and accounting (MC & A) safeguards systems at nuclear fuel cycle facilities. The methodology has been refined into a computational tool, the Version 1 analysis package, that has been used first to assess a hypothetical nuclear fuel cycle facility and more recently to assess operational nuclear plants. The Version 1 analysis package is designed to analyze safeguards systems that prevent the diversion of Special Nuclear Material from nuclear fuel cycle facilities and to provide assurance that diversion has not occurred.

240 **(NUREG/CR—1610-Vol.1-No.4) Inspection methods for physical protection project. Volume 1, No. 4. Annual report, March 1980-February 1981.** Armantrout, G.A.; Bowden, D.D.; Green, J.N.; Minichino, C.; Savage, J.W.; Thatcher, R.M.; Tyler, G.C. (Lawrence Livermore National Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 29p. (UCID—18123-80-4). NTIS, PC A03/MF A01 - GPO. File Number TI86000913.

This is the second annual report to the US Nuclear Regulatory Commission on progress at Lawrence Livermore National Laboratory in the Inspection Methods for Physical Protection project. The report details the production status of the expanded procedures in the replacement modules for physical protection of power reactors, nonpower/research reactors, strategic special nuclear material fixed sites, and transportation of special nuclear materials. In addition to the replacement modules, new modules have been developed for personnel training and qualifications plan (Appendix B to 10 CFR 73) and for safeguards contingency plans (Appendix C to 10 CRF 73). A new module in licensee implementing procedures has also been developed. All modules are being field tested by Inspection and Enforcement inspectors. Trips, management meetings, data-gathering tasks, and training to complement the modules are also discussed.

241 **(NUREG/CR—1610-Vol.2-No.1) Inspection methods for physical protection project. Volume 2, No. 1. Quarterly report, March-May 1981.** Armantrout, G.A.; Bowden, D.D.; Green, J.N.; Minichino, C.; Thatcher, R.M.; Tyler, G.C. (Lawrence Livermore National Lab., CA (USA)). 26 Jun 1981. Contract W-7405-ENG-48. 22p. (UCID—18123-81-1). NTIS, PC A02/MF A01 - GPO. File Number TI86000946.

This report reviews publication status of expanded procedures in the replacement inspection modules for physical protection of power reactors, strategic special nuclear material fixed sites, and transportation of special nuclear materials, as well as the status of new inspection modules developed for special nuclear material of moderate and low strategic significance at fixed sites, for personnel training and qualifications plan (Appendix B to 10 CRF 73), for safeguards contingency plans (Appendix C to 10 CRF 73), and for licensee implementing procedures evaluation. Progress is also reported on the IE safeguards effectiveness evaluation methodology study, on the computer surety guidance document, on the feasibility study on integration of IE inspector training, and on the study on the integration of physical protection and material control and accounting inspection procedures, methods, and activities. Trips, management meetings, data-gathering tasks, and training to complement the modules are also discussed.

242 **(NUREG/CR—1610-Vol.2-No.2) Inspection Methods for Physical Protection project. Quarterly report, June-August 1981. Volume 2, No. 2.** Armantrout, G.A.; Bowden, D.D.; Green, J.N.; Minichino, C.; Thatcher, R.M.; Tyler, G.C. (Lawrence Livermore National Lab., CA (USA)). 25 Sep 1981. Contract W-7405-ENG-48. 16p. (UCID—18123-81-2). NTIS, PC A02/MF A01 - GPO. File Number TI86000928.

This report to the US Nuclear Regulatory Commission details progress of work during the tenth quarter of the Inspection Methods for Physical Protection (IMPP) project at Lawrence Livermore National Laboratory. Documents submitted as contract deliverables were the "Feasibility Study of the Integration of Physical Protection and MC and A Inspection Procedures, Methods, and Activities" and Computer Surety - Computer System Inspection Guidance. Also submitted was an interim draft of "IE Safeguards Effectiveness Evaluation Methodology." The report describes the IMPP workshops for regional inspectors, as well as trips, management meetings, progress on the videotape "Vulnerabilities of Security Computer Systems," and training to complement the physical protection inspection procedures.

243 **(NUREG/CR—1731) Principles for protecting material accounting systems from data falsification.** Dunn, D.R.; McDonnel, J.L.; Chilton, P.D.; Kufahl, G.E.; Vergari, A.A. (Lawrence Livermore National Lab., CA (USA); Advanced Technology Associates, Inc., Dublin, CA (USA)). 30 Sep 1980. Contract W-7405-ENG-48. 52p. (UCRL—53010). NTIS, PC A04/MF A01 - GPO. File Number TI86000149.

This study is part of a larger effort involving the development of regulatory licensing criteria and guidance for an upgraded material accounting rule for fixed-site, commercial nuclear fuel-cycle facilities. Our approach was to examine the vulnerability events of the Generic Minimal Material Accounting (GMMA) system from the point-of-view of a systems analyst and an internal auditor and then determine some acceptable methods for protecting them. During the course of this task, four protection principles were identified which have the potential of controlling against data falsification: Data Control (DC) - to provide assurance that sufficient controls be involved in the handling of data, especially with regard to the introduction of original data; Control on Controls (CC) - to ensure accuracy, validity, and integrity of information or procedures; Skip Echelon Verification (SEV) - to verify by senders of data that the data are properly used; and Secondary Echelon Forwarding (SEF) - to verify by recipients of data that the data were previously used in an appropriate manner by the sender. The extent to which these or other protection principles should be applied to achieve protection against data falsification and Special Nuclear Material (SNM) diversion depends on the degree of protection desired and the level of threat from which a system must be protected. Data falsification and SNM diversion must involve personnel, and the personnel of concern here are insiders who perform the accounting functions as well as those who have authorized access to the accounting elements. Therefore, protection principles must be implemented with regard to organizational constraints. Our approach to setting organizational criteria is basically to ensure that there is adequate separation of responsibilities for elements of control mechanisms.

244 **(NUREG/CR—1744-Vol.1) Structured Assessment Approach (SAA) input package. Volume 1. Data-gathering handbook (physical security).** Wahler, P.S. (Lawrence Livermore National Lab., CA (USA)). 1 Jun 1981. Contract W-7405-ENG-48. 347p. (UCRL—53007-Vol.1). NTIS, PC A15/MF A01 - GPO. File Number TI86000923.

A description of the data-gathering process for the Structured Assessment Approach (SAA) Input Package is presented in this volume. The Data-Gathering Handbook is divided into two phases, namely, Phase 1: Data-Collection, and Phase 2: Data-Recording. In the data-collection phase, a sequence of questions in the handbook elicits the required information. The data-recording phase rearranges the data that have been collected into a format suitable for entering in a Tektronix 4050 Series Computer. The appendix of this volume demonstrates the use of the SAA Data-Gathering Handbook in a hypothetical nuclear facility.

245 **(NUREG/CR—1774-Vol.2) Structured Assessment Approach (SAA) input package. Volume 2. Data-gathering forms (physical security).** Wahler, P.S. (Lawrence Livermore National Lab., CA (USA)). 1 Jun 1981. Contract W-7405-ENG-48. 113p. (UCRL—53007-Vol.2). NTIS, PC A06/MF A01 - GPO. File Number TI86000919.

A complete set of Structured Assessment Approach (SAA) Input Package Data-Gathering Forms is given in the appendix of this volume. The Data-Gathering Forms are divided into two sections, namely, Section I: Data-Collection, and Section II: Data-Recording. In the Data-Collection Section, the forms offer the analyst a sequence of questions which elicit the information required from a facility. The forms in the Data-Recording Section offer a suitable format for arranging the collected data, which is to be entered into the Tektronix 4050 Series Computer.

246 **(NUREG/CR—2041-Vol.1) Evaluation of an integrated approach to safeguards regulations. Volume 1.** Al-Ayat, R.A.; Judd, B.R.; McCord, R.K. (Lawrence Livermore National Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 69p. (UCRL—53023-Vol.1). NTIS, PC A04/MF A01 - GPO. File Number TI86000916.

This study investigates advantages and disadvantages of an integrated approach to safeguards regulation. We define integrated safeguards regulation as a single, performance-oriented rule governing the performance of both the physical protection (PP) and material control and accounting (MC and A) systems at licensed nuclear fuel-cycle facilities. The study produced a systematic framework for NRC to evaluate the advantages and disadvantages of an integrated approach. Within this framework, we consider the effects of integration on NRC, on licensed facilities and on the public. We present several specific examples of how integrated safeguards could be implemented at licensed facilities. Some of these examples are analyzed quantitatively using the Aggregated Systems Model (ASM) to show how safeguards performance could improve with integrated safeguards. The ASM uses an integrated approach to safeguards evaluation by "giving credit" for the contribution of both PP and MC and A performance in achieving safeguards goals. 12 refs., 11 figs.

247 **(NUREG/CR—2217) Detection of special nuclear materials at portal monitors and location and recovery of contraband special nuclear materials: legal and technical problems.** O'Brien, J.N. (Brookhaven National Lab., Upton, NY (USA)). Sep 1981. Contract AC02-76CH00016. 51p. (BNL-NUREG—51414). NTIS, PC A04/MF A01 - GPO. File Number TI86000976.

This report examines the issues of how reliably special nuclear materials (SNM) can be detected during attempts to steal it and how recovery techniques initiated because of a confirmed theft may affect civil liberties. Chapter II addresses the technical abilities and limitations of detecting SNM under both controlled and uncontrolled conditions. The concepts of "spiking" and shielding are examined. Chapter III discusses the legal requirements and technical limits on detecting small quantities of SNM during smuggling attempts. Assessments are made concerning the type of detectors most desirable and which forms of SNM could logically be spiked to enhance their detectability. Administrative and legal restrictions on portal searches and emergency site responses to SNM losses are comprehensively examined. Chapter IV examines the activity of searching for and recovering contraband SNM. Methods for searching, sources of difficulty, and estimates of sensitivity are made. (All data are unclassified.) The legal implications of area and perimeter searches are examined with particular regard to problems of search and seizure law.

248 **(NUREG/CR—2288) Computer surety: computer system inspection guidance.** (Lawrence Livermore National Lab., CA (USA); Teknekron Research, Inc., McLean, VA (USA)). Jul 1981. Contract W-7405-ENG-48. 157p. (UCID—18975). NTIS, PC A08/MF A01 - GPO. File Number TI86000907.

This document discusses computer surety in NRC-licensed nuclear facilities from the perspective of physical protection inspectors. It gives background information and a glossary of computer

terms, along with threats and computer vulnerabilities, methods used to harden computer elements, and computer audit controls.

249 **(NUREG/CR—4108) Development of MC and A alarm resolution procedures.** Smith, B.W. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 52p. (PNL—5154). NTIS, PC A04/MF A01 - GPO. File Number TI86001824.

The US Nuclear Regulatory Commission is reforming the material control and accounting (MC & A) requirements for facilities authorized to possess and use formula quantities of strategic special nuclear material (SSNM). The purpose of the reform is to strengthen MC & A capabilities by requiring more timely detection of possible SSNM losses and by providing for more rapid and conclusive resolution of discrepancies. This report provides guidance for developing a set of procedures to resolve alarms from the near-real-time loss detection systems. An alarm resolution program distinguishes between a system error and an actual loss of nuclear material. An alarm resolution program consists of procedures to identify causes of alarms, criteria for accepting resolution of alarms, and a program to monitor resolution effectiveness. Development of alarm resolution procedures consists of identifying potential causes of alarms, ordering the general elements of resolution, and determining criteria for accepting resolution. These criteria establish a basis to ensure consistent application of the procedures. A monitoring program is established to ensure acceptable performance of the resolution system.

250 **(ORNL/CSD—128) NLO error propagation exercise: statistical results.** Pack, D.J.; Downing, D.J. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 111p. NTIS, PC E06/MF A01; GPO Dep. File Number DE86001228.

Includes 1 sheet of 48x reduction microfiche.

Error propagation is the extrapolation and cumulation of uncertainty (variance) above total amounts of special nuclear material, for example, uranium or ^{235}U, that are present in a defined location at a given time. The uncertainty results from the inevitable inexactness of individual measurements of weight, uranium concentration, ^{235}U enrichment, etc. The extrapolated and cumulated uncertainty leads directly to quantified limits of error on inventory differences (LEIDs) for such material. The NLO error propagation exercise was planned as a field demonstration of the utilization of statistical error propagation methodology at the Feed Materials Production Center in Fernald, Ohio from April 1 to July 1, 1983 in a single material balance area formed specially for the exercise. Major elements of the error propagation methodology were: variance approximation by Taylor Series expansion; variance cumulation by uncorrelated primary error sources as suggested by Jaech; random effects ANOVA model estimation of variance effects (systematic error); provision for inclusion of process variance in addition to measurement variance; and exclusion of static material. The methodology was applied to material balance area transactions from the indicated time period through a FORTRAN computer code developed specifically for this purpose on the NLO HP-3000 computer. This paper contains a complete description of the error propagation methodology and a full summary of the numerical results of applying the methodlogy in the field demonstration. The error propagation LEIDs did encompass the actual uranium and ^{235}U inventory differences. Further, one can see that error propagation actually provides guidance for reducing inventory differences and LEIDs in future time periods.

251 **(SAND—83-2618) Prototype RECOVER system hardware and software review and future remote monitoring system philosophy. POTAS Task E.59 remote monitoring design review.** Fienning, W.C.; Bailey, F.A. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 12p. (ISPO—207). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001681.

This report describes the first phase of Task E.59 of the Program for Technical Assistance to IAEA Safeguards (POTAS). It contains a design review of the existing prototype RECOVER equipment and preliminary recommendations for an operational, remote monitoring system. The principal conclusions of the design review are related to the limitations of the prototype system regarding communications efficiency and operator interactions. To a large extent, the limitations are a result of the initial RECOVER system conceptual design, and perhaps more importantly, to the technology available when the system was developed. The preliminary recommendations are aimed at eliminating, to the maximum extent possible, the aforementioned limitations through the use of the suggested concepts and current state-of-the-art technology. These recommendations are intended to provide the basis for follow-on Task E.59 activities leading to a detailed conceptual design, including specifications, of an operational, remote monitoring system. Efforts leading to such a design would commence after the overall utility and cost effectiveness of remote monitoring are defined in terms of ultimate routine use of such a system by the IAEA.

252 **(UCRL—53668) DOE site-specific threat assessment.** West, D.J.; Al-Ayat, R.A.; Judd, B.R. (Lawrence Livermore National Lab., CA (USA)). 12 Jul 1985. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002361.

A facility manager faced with the challenges of protecting a nuclear facility against potential threats must consider the likelihood and consequences of such threats, know the capabilities of the facility safeguards and security systems, and make informed decisions about the cost-effectivness of safeguards and security upgrades. To help meet these challenges, the San Francisco Operations Office of the Department of Energy, in conjunction with the Lawrence Livermore Laboratory, has developed a site-specific threat assessment approach and a quantitative model to improve the quality and consistency of site-specific threat assessment and resultant security upgrade decisions at sensitive Department of Energy facilities. 5 figs.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

253 (INIS-mf—9472, pp 72) **Development of silica gel-based /sup 113m/In generator.** Kopecka, B. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

254 (INIS-mf—9472, pp 73) **Czechoslovak /sup 113m/In generator.** Kopecka, B. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

255 (INIS-mf—9472, pp 77) **New generator of ultra-short-lived /sup 137m/Ba.** Koprda, V.; Sedlackova, E.; Scasnar, V. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalnej Farmakologie). 1981. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

256 (INIS-mf—9910-Vol.2, pp 1-4) **Heavy water drum fabrication.** Pelletier, J.-P.; Labelle, R. (Fabricon Steel and Stainless Fabricators Ltd., Sherbrooke, Quebec (Canada)). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

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From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).
Published in summary form only.

257 (INIS-mf—9910-Vol.2, pp 86-99) **Production of 132 Cs, a positron emitter.** Durocher, J.J.G.; Gusdal, I.; McKee, J.S.C; Friesen, C.; Gallop, D. (Manitoba Univ., Winnipeg (Canada). Cyclotron Lab.). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

There is a developing need for production of a positron emitting cesium isotope for use in the study of antitumor effects in laboratory animals, and sup(132)Cs is particularly suitable because of its suitable half-life, ease of production and biomedical convenience. Generation of the radioisotope through deuteron or neutron induced reactions was rejected in favour of proton induced processes using the University of Manitoba Spiral Ridge Cyclotron. The sup(133)Cs(p, pn)sup(132)Cs reaction was finally selected in favour of alternates such as sup(132)Xe(p, n)sup(132)Cs, particularly because of the difficulty and cost in obtaining the enriched xenon isotope. CsCl crystals with a total mass of 0.5 gm were wrapped in an aluminum foil pouch and irradiated with protons of energies between 10 and 18 MeV in order to maximize the yield from the reaction process.

0702 Radiation Sources

258 (INIS-mf—9905, pp 35-46) **Sealed sources for materials testing.** Vondruska, V. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1983. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091. (CONF-8310399—).

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

The revision is being prepared of several standards which are to be replaced by one single standard, and of decrees issued by the two national ministries of health care, on health protection from ionizing radiation. It has been suggested that the validity period of the certificate should be replaced by a recommended service life of the sealed source and recommended intervals of leakage testing by UVVVR and the user. The suggested amendment distinguishes authorized tests carried out by the manufacturer and in-service tests carried out by the user. The determination of service life should take into consideration data provided by the manufacturer, the area of use of the sealed source, environmental impacts during operation and experience gained with similar types of sources.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 541, 1208

259 (EPRI-EM—4256) **Technoeconomic evaluation of large-scale electrolytic hydrogen production technologies. Final report.** Soychak, T.J.; Pitayagulsarn, P.; Paik, K.; Riter, J.B. (Stone and Webster Engineering Corp., Houston, TX (USA)). Sep 1985. 101p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920012.

This study for EPRI evaluated the economics for a standalone electrolytic hydrogen (EH_2) facility using commercially available large-scale electrolyzers from vendors in the US, Canada, and European countries. The advanced SPE water electrolysis technology of General Electric was also included. The plant design for each technology was evaluated to determine the commercial status and the levelized EH_2 production costs relative to the cost of electricity and various financial parameters. Present day (1984) production costs for EH_2 were also compared with the present day costs for hydrogen produced via steam reforming of natural gas. Of the eight licensors contacted, only three manufacturers provided technical and cost information. These were Electrolyser Inc. in Canada, Norsk Hydro in Norway, and Brown Boveri Corporation in Switzerland. Stone and Webster Engineering Corporation's (SWEC) in-house information was used for the advanced GE SPE Water Electrolysis Technology. Based on the techno-economic comparison of the above four technologies, a reference technology was selected for a potential site-specific application for the National Aeronautics and Space Administration (NASA) at the Kennedy Space Center (KSC). This site-specific study evaluated the economics of producing EH_2 and electrolytic oxygen (EO_2) as well as liquifying the EH_2 and EO_2 for use in the space shuttle program. 26 figs., 18 tabs.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 136

260 (DOE/PC/50810—T11) **Promotion effects on the synthesis of higher alcohols. Final report.** Goodwin, J.G. Jr.; Chuang, S.C. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 30 Aug 1985. Contract FG22-82PC50810. 243p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85018269.

The importance of the direct syntheses of higher (C_2-C_6) alcohols from synthesis gas as a promising route for providing clean fuels and petrochemical feedstocks is generally recognized. It is known that the addition of alkali salts to methanol synthesis catalysts increases the production of higher alcohols. However, few investigations have been made into the effect of various alkali species on the synthesis of oxygenates from CO and hydrogen. A series of research studies have been carried out which greatly expand current knowledge in this area. The objectives of these studies were to investigate the reaction pathways for and the effect of alkali promotion (Li^+, K^+, Rb^+, Cs^+) on the formation of oxygenated compounds from synthesis gas. A series of Group VIII metals (Ni, Ru, Rh, and Pd) and alkali-promoted Rh and Pd catalysts were studied using CO hydrogenation and a chemical probing method with ethylene, ethanol, and acetaldehyde as probe molecules. The chemical probing method developed for this study was demonstrated to be an effective way to: (1) identify the possible reaction network occurring on these catalysts; (2) study the interrelationships between oxygenate and hydrocarbon synthesis; (3) determine the catalytic properties of the catalyst surfaces; and (4) investigate support and alkali promotion effects on the reaction pathways to oxygenates and hydrocarbons. 150 refs., 27 figs., 46 tabs.

261 (DOE/R2/05152—T1) **Methane production from grape skins. Final technical report.** Yunghans, W.N. (State Univ. of New York, Fredonia (USA). Dept. of Biology). 9 Oct 1981. Contract FG42-80R205152. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000474.

Methane production from grape pomace was measured for a 50-day digestion period. Gas production was calculated to be 2400 ft^3/10 d/ton at 53% methane content. Microorganisms particularly a fungus which grows on grape pomace and lignin was isolated. Lignin content of pomace was measured at approximately 60%. Lignin is slowly digested and may represent a residue which requires long term digestion. Research is continuing on isolation of anaerobic methane bacteria and codigestion of pomace with enzymes as cellulase and pectinase. The sewage sludge functioned adequately as a mixed source of organisms capable of digesting grape pomace. A sediment from stored grape juice produced significant amounts of methane and represents a nutrient substrate for additional studies on continuous flow methane production. 3 figs.

262 (DOE/SF/01949—T1) **Methane digester for wastewater grown aquatic plants. Final report.** (Solar Aqua-Systems, Inc., Encinitas, CA (USA)). 1976. Contract FG03-78SF01949. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000442.

The purpose of this project was to build and test a small-scale, prototype anaerobic digester using wastewater grown aquatic

plants as feed stock. Two 150 gal. digesters of the horizontal "bag" shape were constructed and fed with water hyacinths and duckweed plants grown on wastewater. Bio-films were added to increase methane bacteria surface attachment area, and solar heating was used to increase operating temperatures. Repeated difficulties were encountered with the low cost materials and construction techniques used, causing leaks of liquids and methane gas, and in the solar heat exchanger. As a consequence, no reliable data were obtained on performance. Due to an inadequate budget, the project was terminated without making construction changes needed to properly operate the system for a long period of time. 15 refs., 7 figs.

263 **(DOE/SF/11613—T1) High solids anaerobic digester for rural use. Final technical report.** Goebel, R.P. (EnBio, Inc., Fairfield, CA (USA)). 15 Feb 1983. Contract FG03-81SF11613. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000469.

This report presents the results of a field test of a low cost system for methane production from dry animal manure and other residues. The objective was to determine if a "dry" fermenter, consisting esentially of flexible plastic cover over a large pile of manure, could be developed into a practical on-site fuel production system. The dry (or high solids) fermenter is distinguished from conventional fermenters in that it operates in a batch mode, over a longer period of time, and ferments the substrate as a semi-solid, rather than as a slurry. Since many of the potential substrates for dry fermentation cannot be fermented economically using conventional methods, a distinct niche exists for this technology. The project was conducted at the Emerson Dairy, in Oakley, California. A pile, about 102 yd^3 in volume, was constructed with old dairy manure scraped from a corral. Water from the dairy's manure flush system was added, bringing the total solids level down to about 50%. Water addition was terminated when it began to flow from the bottom of the pile. The pile, containing an estimated 38,000 lb of volatile solids was covered with a sheet of Hypalon on July 28, and gas production and composition was monitored until November 30. Gas production peaked at about 400 ft^3/day in late August, and declined to about 50 ft^3/day by the end of November. Cumulative gas production was about 18,000 ft^3, with an average methane content of 67%. The total gas production was considerably lower than expected, based on the amount of volatile solids present. Although a large portion of the volatile solids was no doubt refractory (non-biodegradable), the low gas yield is probably the result of the solids content of the manure being too high, or conversely, the moisture content being too low.

264 **High primary air biogas range burner.** Zhenghou, J.; Chengjun, Z.; Niangu, W.; Qingguan, Y.; Huijun, Q. (Dept. of Mechanical Eng., Tongji Univ.). pp 1043-1052 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Biogas has an extremely low burning velocity and lifting limit. The current range burner ports for coke oven gas, natural gas and liquefied petroleum gas (LPG) are not suitable for biogas because of flame unstability. Using multi-hole port can increase lifting critical input rate under high percent primary air. Two types of high primary air biogas range burners have been designed and tested. These burners produce short and sharp flames which will not spread out of the pot even under a high input. The heat efficiencies of these ranges increase with increase of percent primary air. The carbon monoxide content of flue gas does not vary significantly with percent primary air as would be expected. The heat efficiency of introduced biogas ranges are about 60%.

265 **Methanation with transition element catalysts.** Happel, J.; Hnatow, M.A.; Bajars, L.; Fushan, Y.; Lee, A.L. (Catalysis Research Corp.). pp 406-414 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The mechanisms of methanation over MoSX and Ni catalysts were studied using transient isotopic superposition techniques, employing acC and D. The data on MoSX indicate that the most abundant reacting intermediate is the CH(a) species. There is a small pool of active carbidic species and a much larger pool of adsorbed hydrogen. For MoSX the ratio of H(a) to C(a) was about 360 to 1 as compared with 1.8 to 1 over nickel catalyst. This explains why the MoSX catalyst does not present problems with carbon formation. Another important ratio is the amount of CH(a) to total carbon and hydrogen species. For MoSX this ratio is 0.86 as compared with 0.56 for nickel catalyst. This indicates that the rate controlling step in both of MoSX and nickel is the hydrogenation of the CH(a) species. These characteristics of the catalyst which have been developed for direct methanation make it possible to methanate at low Hr to CO without deactivation by carbon formation and the need of steam to prevent carbon formation such as experienced with commercial nickel catalyst.

266 **Acidogenesis of macroalgal components in anaerobic digestors.** Forro, J.R.; Lescinski, D.M. (Bio Chem Technology, Inc.). pp 488-495 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Methanogenic digestion systems utilizing marine-derived biomass feedstock (macroalgae) have been investigated microbiologically and biochemically as part of an assessment of the utility of these systems as alternate natural gas sources. Of particular interest in this study, was the microbial breakdown of the major structural/storage materials in the macroalgae and the mechanisms controlling these reactions. Mannitol is utilized by a wide spectrum of organisms which produce a variety of metabolic end products including acetate, lactate, hydrogen, and carbon dioxide. Control of mannitol degradation is through inducible mannitol dehydrogenases and cellular transport processes. Polymer degradation ability appears to be more restricted, with Cytophaga sp seeming to predominate. Extracellular inducible polysaccharide degrading enzymes for algin, laminarin and agar have been identified and partially characterized. The main metabolic products derived from growth on these carbohydrates are acetate and propionate. The metabolic pathways allowing for complete degradation of algin and mannitol have been elucidated.

267 **Bioengineering concepts for methane enrichment in anaerobic digestion.** Hayes, T.D.; Isaacson, H.R. (Gas Research Inst.). pp 496-510 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A major economic consideration in the use of anaerobic digestion to convert biomass and wastes to pipeline quality methane is the cost of separating CO_2 from the product gas. The cost of physical-chemical processing for upgrading digester gas (55-65 percent CHt) to a methane gas stream meeting Gas Industry specifications (> 95 percent CHt) is high, typically ranging from $1.50 to 3.00/GJ. Certain anaerobic digestion process designs have the potential of achieving higher methane concentrations in the product gas thereby reducing gas cleanup costs. There are at least three inherent features that make anaerobic digestion uniquely suited to gas separations: 1) the presence of a gas/liquid interface, 2) the phased production and utilization of volatile acids, and 3) the capability of anaerobic bacteria to produce methane against elevated gas pressures. Because the solubility of Co_2 in water is many times greater than that of methane, it should be possible to develop reactor schemes capable of achieving efficient separations of these two gases. An equilibrium model has been developed that predicts the methane and CO_2 content of the product gas of a steady state digester as a function of commonly-measured influent and effluent parameters. This model, when tested with existing data, showed good correlation between predicted and observed values for methane content. On the basis of the model and the literature, a two-stage, pH-swing/pressure-swing digestion scheme has been conceptualized that has the potential of producing high-Btu gas (90-95% CHt) directly from organic wastes and biomass.

268 **Characterization of a marine methanogenic consortium.** Sowers, K.R.; Ferry, J.G. (Dept. of Anaerobic Microbiology, Virginia Polytechnic Inst. and State Univ.). pp 527-536 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The following conclusions are drawn from the results presented in this study. 1) A complete kelp degrading methanogenic consortium consisting of a close association of three physiologically distinct groups of bacteria occurs in marine sediments. 2) This marine microbial food chain is not inhibited by high salt concentrations found in kelp (Kelco, 1976) which causes inhibition of freshwater digesters and methanogenic bacteria (26,32,42). 3) The food chain effectively degrades the two major components of kelp, alginate and mannitol, simultaneously and efficiently, with greater than 90% of the estimated content of alginate and mannitol being degraded to CHt. 4) The population of methanogenic bacteria in the marine consortium is equally diverse in morphology and physiology to that found in a freshwater consortium. 5) The marine consortium has a high capacity for maintaining low Hr partial pressure and our results suggest that interspecies Hr exchange has an important regulatory role. 6) The high concentrations of acetate and propionate indicate that utilization of these substrates may be limiting in this system. Rapid degradation of these intermediates may be achieved as the population dynamics of the system is established in a continuous feed system.

269 **Production of methane from fast-growing hardwoods.** White, E.H.; Chynoweth, D.P.; Isaacson, H.R. (SUNY College of Environmental Science and Forestry). pp 580-593 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Short-rotation intensive culture of hybrid poplar plantations or wood biomass production is becoming more popular as demand for alternative energy resources increases. Annual utilizable yields per acre on short-rotation coppice systems is much greater than by conventional forest practices on long rotation. To obtain the yields reported in current research publications by the new system the trees must be successfully established, harvested and regenerated. Establishment includes site selection and preparation, planting and tending involving cultural treatments. The minimum time required for successful establishment in the northeastern United States is generally two growing seasons after planting. Anaerobic digestion was selected as the gasification process because of the high quality of the product gas and favorable economics at a variety of scales. Woody biomass without pretreatment is generally considered to be refractive to anaerobic decomposition. This refractory property is attributed to its low moisture content, crystalline nature of the cellulose, and complex association of the component carbohydrates with lignin. This study investigated the methane fermentation (anaerobic digestion) of various wood species using conventional anaerobic digestion and batch anaerobic biogasification potential assays.

270 **Economics of methane from hyacinth wastewater treatment systems.** Smith, M.D.; Filardi, R.E.; Curran, G.M.; Miller, G.R. (Black & Veatch, Engineers-Architects). pp 668-677 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

An economic and financial comparison of alternative water hyacinth wastewater treatment/methane production systems was performed using the Gas Research Institute's "Levelized Cost of Service Price Model". The model was used to calculate a uniform annual cost of service price over the service life of the project, expressed in base year dollars. Water hyacinths were used as a means of wastewater treatment as well as a source of biomass for methane production. The cost of service price varied from about $2.50 per thousand cubic feet, associated with primary treatment followed by hyacinth treatment for a 76 x 10c mc (50 x 10f gallons) per day raw wastewater facility, to $75.00 per thousand cubic feet, associated with hyacinth polishing of secondary effluent for a 3,800 mc (1 x 10f gallons) per day facility.

271 **Biogasification of water hyacinth and primary sludge.** Chynoweth, D.P.; Biljetina, R.; Srivastava, V.J.; Dolenc, D.A.; Hayes, T.D.; Milanowski, J.E. (Inst. of Gas Tech.). pp 656-667 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A research program centered around a facility located at Walt Disney World (WDW), Orlando, Florida, is in progress to evaluate the use of water hyacinth (WH) for secondary and tertiary wastewater treatment, to optimize growth of WH under these conditions, and to convert the resultant primary sludge (PS) and WH to methane via anaerobic digestion. This article describes the status of the biogasification component of this program, which includes baseline and advanced digestion experiments with individual feeds and blends for the design and operation of an experimental test unit (ETU) at WDW. Experiments with several blends demonstrated that methane yields can be predicted from the fractional content and methane yield of each component. The process was found to adhere to the Monod kinetic model for microbial growth, and associated kinetic parameters were developed for various feed combinations. A novel upflow digester is achieving significantly higher conversion than a stirred-tank digester. A larger-scale (4.5 mc) ETU was designed, installed and started up at WDW in 1984. This unit is being used to evaluate scale-up of laboratory data and materials handling.

272 **Analysis of first three years' data controlled landfill project, Mountain View, California.** Van Heuit, R.E. (EMCON Associates). pp 646-655 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A number of studies have been conducted in the United States to define the most important factors influencing the yield and generation rate of landfill-derived methane. Found to be most important were (1) refuse composition, (2) refuse moisture content, and (3) pH of the aqueous phase. Other factors which are also significant, though of less importance, are: (1) temperature conditions in the landfill, (2) the quantity and quality of nutrients, and (3) the density of in-place refuse. The laboratory and small-scale field studies conducted to date have, however, provided only qualitative data on the impact of the suggested enhancement parameters on methane production. To provide the quantitative data necessary to establish the functional relationships between the methanogenic process and the enhancement parameters, and to assess the enhancement process from a field management point of view, a large-scale field demonstration study is underway at the Mountain View Landfill in Mountain View, California. The overall objectives of the Mountain View Controlled Landfill Project are to demonstrate the feasibility of landfill gas enhancement in the field and to collect important kinetic information which will facilitate the development of more accurate models of landfill gas production.

273 **Technical and economic feasibility of the production of methane from kelp, Macrocystis.** Bird, K.; Ashby, A. (Gas Research Inst.). pp 613-621 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Kelp production and cultivation as a renewable resource for bioconversion to methane has been demonstrated to be technically feasible in benchscale anaerobic digestion and half acre kelp yield experiments. In 1982, these experimental data were integrated into a systems study which projected state-of-the-art levelized gas costs from kelp systems at $13/Gjoule ($1982). Recent improvements in anaerobic digestion systems and improved economies of scale have lowered these estimated gas costs to $8/Gjoule. Further improvements in kelp yields, bioconversion rates and harvesting technol-

ogies can reduce gas costs to $6/Gjoule, a price projected to be competitive with other substitute natural gas prices in the year 2000.

274 **Sorghums for methane production.** Hiler, E.A.; Isaacson, H.R. (Texas Agricultural Experiment Station, Texas A & M Univ. System). pp 605-612 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

This paper provides a summary of first-year research activities in the sorghums-for-methane program sponsored by Gas Research Institute (GRI) and cofunded by Texas Agricultural Experiment Station (TAES). The overall objective of this research is to develop an integrated system for methane production utilizing high-energy sorghum as the feedstock. Researchers in the program include plant breeders, sorghum physiologists, agronomists, agricultural and systems engineers, and agricultural economists. Major research emphases are genetic manipulation, physiology and production systems; harvesting, storage, processing and conversion systems; and economic and systems analyses. First-year results indicate that (1) the proposed sorghum-methane system is in the realm of economic feasibility, (2) research emphases in storage and high-efficiency conversion are critical to the economic implementation of the system, and (3) an improved economic situation can be realized if it is feasible to harvest the grain and vegetative material for separate purposes, food and energy.

275 **Review of the potential for biomass resources and conversion technology status.** Lipinsky, E.S.; Young, B.A.; Sheppard, W.J.; Jenkins, D.M. (Battelle Columbus Lab.). pp 594-604 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The GRI biomass program was conceived during a fuel crisis and before partial deregulation of natural gas prices. Under the circumstances that exist now, the need for new natural gas supplies at any cost has been replaced by the need to meet rather stringent price, quantity, and environmental requirements. As part of GRI's evaluation of its overall program, Battelle, Columbus Laboratories reviewed the potential for biomass resources and conversion technology with respect to the possible contributions of biomass and wastes to a low-cost, secure natural gas supply. The study indicated the extent and usability of current knowledge, or the lack thereof, and identified economic and research and development issues requiring further attention. This paper is intended to summarize some of the major findings of the study.

276 **Investigations of Sargassum species for bioconversion to methane: Mannitol levels, temperature requirements, and protoplast formation.** Preston, J.F. III; Romeo, T.; Gibor, A.; Polne-Fuller, M. (Dept. of Microbiology and Cell Science, Univ. of Florida). pp 567-579 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

As candidates for biomass production, species of the marine algal genus Sargassum have been examined to identify desirable phenotypes and develop methods for cultivation and genetic manipulation. The pelagic species S. fluitans and S. natans as well as the benthic species S. filipendula, S. hystrix, and S. pterpleuron, all of are common to the coastal waters of the southeastern United States, have been evaluated with respect to mannitol levels. S. filipendula and S. hystrix contained 2- to 3-fold the concentration of mannitol compared with the other species on a weight basis. Temperature requirements for optimal growth as well as tolerances were determined for the cold water species S. muticum and S. sinicola as well as some of the warm water species listed above. The warm water species show low and high temperature tolerances of 5 to 7 and 2 to 10 deg C, respectively, above those for the cold water species. Procedures for removing associated bacteria have been developed and unialgal and/or axenic cultures of selected species have been obtained. Mechanical and enzymatic methods have been developed for the preparation of protoplasts from selected species preliminary to the isolation of clones for axenic propagation and somatic hybridization between species.

277 **Implications of the structure and metabolism of Methanosarcina mazei to anaerobic digestion.** Aldrich, H.C.; Bleiweis, A.S.; Smith, P.H.; Robinson, R.W.; Hurst, S.F.; Mah, R.A.; Lui, Y. (Dept. of Microbiology and Cell Science, Univ. of Florida). pp 557-560 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Regulation and control of acetic acid metabolism can significantly improve performance of digesters for methane production from biomass. Methanosarcina (=Methanococcus) mazei (Barker) Mah and Kuhn is crucial in acetic acid conversion in digesters operated at mesophilic temperatures. The authors are working toward manipulating its aggregation and fragmentation to enhance acetic acid metabolism in anaerobic digesters. An increase in metabolically active cellular units would raise the rate of acetic acid conversion. M. mazei cells are typical of Gram-variable prokaryotes, with pleomorphic, irregular cells, grouped into multicellular aggregates which periodically fragment. The protoplast is bounded by a typical trilaminar plasma membrane, outside of which is a capsule of loose fibrils. The protoplast contains phosphate storage granules, but no internal membranes. The cell envelope contains complex heteropoly-saccharides of N-acetyl-galactosamine, galacturonic and glucuronic acids. Polymers extruded by M. mazei are likely quite adhesive in nature, accounting for its strong adherence to surfaces and hardiness compared to many other methanogens.

278 **Engineering design considerations for methane fermentation of energy crops.** Jewell, W.J.; Cummings, R.J.; Rector, D.J.; Richards, B.K. (Dept. of Agricultural Eng., Cornell Univ.). pp 537-550 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A simple "dry methane fermentation" process was developed in previous studies for the conversion of wheat straw and cornstalks. This ongoing study extends this approach to energy crops such as sorghum and napier grass. The goal is to define the fundamentals of digestion of energy crops so that an optimized conversion system can be developed. Emphasis in early experiments is focused on development of conversion kinetics and evaluation of factors that influence the rates and the efficiencies of the conversion processes. Criteria for an "optimized" system include maximum net energy production and minimal chemical and microbial additions and post-harvest handling. Conventional wet digestion of these substrates requires retention times in excess of 100 days and appears to have practical limitations, including substrate flotation and separation. Multiple cycle digestion in high-solids batch reactors has achieved greater than 60 and 80 percent volatile solids conversion in less than 100 days for napier grass and sorghum, respectively (at temperatures of 35\C and 55\C).

279 **Biotechnology and the Gas Industry.** Bird, K.; Isaacson, R. (Gas Research Inst.). pp 521-526 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

While biotechnology is playing a very limited role in the gas industry, there is considerable interest by the liquid fuels industry in biotechnology applications for enhanced oil production and alcohol fermentation. Similar technologies could be developed for the gas industry. Among these are coal desulfurization, lower cost environmental cleanup of gas technology produced wastes, enhanced gas recovery, specialized drilling fluids, and of course, improvements in biomass to methane systems and waste conversion processes. Currently, there has been no real interaction between biotechnologists and gas industry technologists. Such an interaction could more clearly delineate research areas where biotechnology could impact the recovery of gas, coal conversion, and improved environmental

systems. Biotechnology will continue to play an important role in the technological development of the United States. Its role in aiding the gas industry has serious merit and warrants R&D support.

280 **BIOMET: A simulation model for study of biomass to methane systems.** Mishoe, J.W.; Boggess, W.G.; Kirmse, D.W. (Chemical Eng. Dept., Univ. of Florida). pp 511-520 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The development of BIOMET is an on going activity that has not been completed. It however is a very useful tool for integrating new research information and determining the impact on the overall performance of the system. The additional work will focus on the development of process conversion models. The conversion of the biomass to methane represents about 60 to 70% of the total cost of the gas. By improving this technology the authors will be able to greatly reduce the cost of methane. They have identified several problem areas in the management of the biomass crop. One of these is the unknown effect of multipie harvests. They are in the process of modeling this crop response so they will be able to study various management options to prevent major yield losses. They also plan to investigate the risk factors associated with major events causing crop loss. As determined in this report to be cost effective the system must not be limited by a lack of biomass. Protection from biomass shortages caused from events such as freezing temperatures must be designed into the system. Results indicate that methane produced from biomass can be cost competitive with other energy sources.

281 **Anaerobic digestion of municipal solid waste potential market and implications.** Sjoberg, H.T.D. (Waste Management, Inc.). pp 678-689 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The U.S. Department of Energy and the Gas Research Institute are developing a process for the anaerobic digestion of municipal solid waste and sewage sludge to methane. Known as RefCOM (Refuse Conversion to Methane) the experimental facility in Florida can process 100 tons of raw refuse per day with an output of up to 350,000 cubic feet of methane per day. The objective of the RefCOM project is to verify laboratory data, optimize parameters and evaluate the reliability of the process. The test program to date has verified that the technology is cost-effective. The current status of the operation will be presented, along with a brief review of the potential market. This process can provide a service to many municipalities in the U.S. How and where it might be applied and the potential benefits of the process will be discussed from an industry point of view.

282 **Kolbe electrolysis of mixtures of aliphatic organic acids.** Levy, P.F.; Cheng, L.K.; Sanderson, J.E. (Dynatech R/D Company, Cambridge, Massachusetts). *Journal of the Electrochemical Society;* **131**: No. 4, 773-777(Apr 1984).

Kolbe electrolysis of mixtures of n-butanoic with n-hexanoic acid and propranoic with n-hexanoic acid have been performed in aqueous solution at a smooth platinum anode. Typically, hexane production by the oxidation of butanoic acid, or butane production from propanoic acid, in aqueous solution is not observed to exceed a few percent In the current work, significant increases of these products were observed. In addition, a substantial fraction of the remaining C_3 or C_4 acids reacted were converted to mixed alkane dimers with hexanoic acid. These results are interpreted by a model in which n-hexanoic acid and its various oxidation products form a lipophilic layer at the anode surface which provides an environment where further oxidation to carbonium ions is disfavored. This model has been suggested previously to explain pressure effects on Kolbe electrolysis. This observation supports the feasibility of producing mixed linear alkanes for use as fuels and chemicals from mixed organic acids which may be produced by anaerobic fermentation of organic matter.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 863, 865

283 **(CONF-7910328—Pt.2) High Plains Energy Forum. II. Fuels, alcohol, and methane.** Rich, D.; Browne, M. (eds.). (High Plains Energy Forum, Dodge City, KS (USA)). 1980. Contract FG01-80CS83003. 46p. High Plains Publishers, Inc., Dodge City, KS. File Number TI85010317.

From High plains energy forum: fuels, alcohol, and methane; Dodge City, KS, USA (19 Oct 1979).

This report contains the presentations of 7 speakers at the Energy Forum. Topics included are: methane plants (farm size); methane plants (large scale); utilization of waste products; wood burning; fuel options (alcohol); lifestyles tied to liquid fuels; and the future of alcohol fuels (a panel discussion). (DMC)

284 **(DOE/R2/05173—T1) Three-stage fermentation process: cellulose-ethyl alcohol. Final technical report.** (Pace Univ., Pleasantville, NY (USA)). 30 Oct 1981. Contract FG42-80R205173. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000480.

In summarizing the one year study the following observations were noted: (1) Trichodermal enzymes produced by the methods outlined gave a Filter Paper Activity (FP Activity) of 1.5 to 2.0 FP units per ml; (2) Sclerotium enzyme production was evident, but to date we have not been able to definitely enhance Trichodermal enzyme activity by the addition of the former; (3) Enzymatic hydrolysis of newsprint strips was enhanced by using a chemical pretreatment involving Alkaline bisulfite for 3 days followed by 2% H_2SO_4 also for a 3 days period at 25°C; (4) Aspergillus niger was grown on 1% Xylan and an enzyme (Xylanase) was active in producing the sugar, Xylose; (5) Treatment of newsprint with both Trichoderma & Aspergillus enzymes yielded at least three sugars - cellobiose, glucose, and xylose; (6) Yeast fermentation of recoverable sugars from newsprint was accomplished, however due to the limited time period no attempt was made to purify the fermentation products. Thus our findings are based primarily on the CO_2 production during the yeast fermentative period (36 to 48 h). 11 refs.

285 **(DOE/R4/10353—T1) Design and operation of a small-scale ethanol still.** Floyd, J.E. (Floyd (James E.), Cullman, AL (USA)). 1980. Contract FG44-80R410353. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000587.

A description is presented of a small-scale alcohol still utilizing beer derived from both corn and potato mash. Use was made of the ethanol in alcohol vehicles imported from Brazil. By-products (stillage) were successfully used as cattle feed. (DMC)

286 **(DOE/SF/10570—T1) Papaya drying and waste conversion system. Final report.** (La Malo'o Dried Fruit, Pahoa, HI (USA)). 12 Feb 1982. Contract FG03-79SF10570. 18p. (HI—79-005). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000349.

This project, performed under United States Department of Energy Small-scale Appropriate Energy Technology Grant, involves demonstration of an integrated system using solar energy to process off-grade or reject fruit into marketable food products. The integrated system consists of three phases: (1) solar dehydration of usable fruit; (2) solar vacuum distillation of fermented wastes (peelings, rinds, skins, and seeds) to produce an ethanol fuel to use as a backup source of heat for dehydration; and (3) land reclamation by mixing stillage and compost with volcanic cinder and ash to produce on marginal land a rich soil suitable for growing more crops to dry. Although the system is not 100% complete the investigators have demonstrated that a small business can efficiently use solar energies in an integrated fashion to process waste into food, improve the quality of the land, and provide meaningful jobs in a region of very high unemployment.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 1208, 1209

287 **(DOE/OR/21389—7) Northeast Regional Biomass Program. Quarterly report, January 1-March 31, 1985.** (CONEG Policy Research Center, Inc., Washington, DC (USA)). 1985. Contract FG05-83OR21389. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001947.

This is the report for the second quarter of the second year of the Northeast Regional Biomass Program. The objective of the program is to promote the responsible use of biomass energy by the public and private sectors in the 11-state Northeast region. During this quarter, 9 of the 11 states began work on second year grant programs. A tenth state, Delaware, completed its first year program and will begin its second year program on April 1. The final state, Maryland, has yet to submit a grant proposal, but has received an extension on its first year program. As indicated in the body of this report, several states are still completing first year programs and many have carried over funds from year 1 to year 2. Final reports from all first year contractors were completed and published during this quarter. In addition, a contract awarded to the Northeast States for Coordinated Air Use Management (NESCAUM) was completed and the result is a guide to state air quality regulations affecting industrial woodburning in the region. Work has begun on each of the three technical subcontract projects described in the last quarterly report. In addition, a contract for publication of the Biologue newsletter was entered into with the National Wood Energy Association. The status of each project is briefly summarized in this report.

288 **(DOE/R1/23271—T1) Electronic control of wood combustion.** Guernsey, D.W. (Guernsey (David W.), Concord, MA (USA)). Nov 1982. Contract FG41-81R123271. 12p. (MA—81-013). NTIS, PC A02. File Number DE86000375.

A new wood burning furnace is designed which emphasizes secondary combustion with a system of electronic controls. The apparatus fabricated for the project succeeded in sustaining distinctly separate secondary combustion for an excited period of time. Although the project did not include apparatus for emissions analysis, the electronic controls did appear to control the combustion air effectively. The project was thus able to study one of the suggested techniques for achieving efficient combustion with low emissions levels. The major problem uncovered is that, in order to achieve the necessary ignition temperature to initiate secondary combustion, the firebox temperatures must be high. This induces pyrolization of the fuel at a rate which can be too high for the heat demand. This conundrum can only be overcome by providing an auxilliary ignition source to initiate secondary combustion. Work on the project is continuing in the following areas: (1) improvement of the apparatus by use of more suitable materials; (2) investigation of use of catalysts as an auxiliary ignition source; and (3) investigation of possibilities for dissemination of the results of the project. 3 refs., 3 figs.

289 **(DOE/R1/26232—T1) Compact unit for the continuous distillation of hardwood and recovery of byproducts. Final technical report.** Morselli, M.A. (Wever, Inc., South Burlington, VT (USA)). 14 Jan 1983. Contract FG41-81R126232. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000363.

This is the final report on a grant to design and to build a wood distillation unit which could be operated with a minimum of labor, using locally available hardwood as raw material. This wood distillation unit would be compact and simple in its components, sturdy in construction, reasonably low priced, and easy to assemble and disassemble for its relocation from one area to another in the State. A prototype became operational in January 1982. It was run at first in a closed shed rented in the Town of Milton, 22 miles north of Burlington, Vermont. A pallet manufacturer in the same town supplied the hardwood wastes used in the prototype retort. At this time, we designed and built a low cost solar wood dryer used to store the wood blocks which fed the distillation unit; these blocks were cut from the hardwood wastes. The results with the prototype retort indicated that a new approach should be adopted in the design and construction of the large distillation unit. Several adjustments and improvements had to be made in the course of the following weeks, especially to the burner system. At the beginning only short runs at one third of the retort capacity were conducted. By October 1st, we reached 50% of total capacity. Distillation runs with temperatures over 600°F were achieved by October 16. At that time, a crack was noticed and quickly repaired on the welding line of the retort. Distillation tests were conducted on the condensate by using a large glass column (800 mm x 50 mm) connected to an air condenser and to a 3 liters flask. Fractions boiling over 103°C were thus separated from lower boiling fractions. If necessary, this semilab distillation column could be modified to separate fractions boiling at different temperatures. By November 24, the last distillation was run, and five days later we discharged the last mass of charcoal.

290 **(EGG-EA—6775) Evaluation of densification technologies.** Steverson, E.M.; Semler, T.T.; Goldsberry, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1985. Contract AC07-76ID01570. 204p. NTIS MF A01; 2; GPO Dep. File Number DE86002326.

The purpose of this work is to assess and evaluate the state-of-the-art of densification technology as applied to producing densified refuse-derived fuels (d-RDF). Aspects of the technology, such as performance, economics, pacing problems, operational practice, and available equipment are addressed. The first part of this report describes the chemical, physical, handling, storage, and combustion properties of d-RDF. Data from the various studies and commercial plants that produced d-RDF were obtained and collated to present an overall assessment of d-RDF as a fuel. The next section presents an evaluation of pellet mills in d-RDF production applications. The majority of d-RDF production processes have involved pellet mills. Data from various tests and visits with pellet mill manufacturers served to provide the information presented. An in-depth technical description of the extrusion process is included, and is also applicable to the cubing and extruding processes. A life-cycle economic analysis of a d-RDF production plant, using cost information on the pellet mill is also presented. Parts four and five of this report present an assessment of the cuber and other densification techniques. Operating experience on RDF using these techniques is limited, compared to pellet mills, and much of the information presented in speculation by the manufacturers and consultants in the field. The final section presents an overall assessment of the state of the d-RDF production industry. 84 refs., 35 figs., 17 tabs.

291 **(STEV-FBA—84-17) Grate firing of pellets in modified small boilers.** Ravnsborg, J.; Loevgren, B.E. (Statens Energiverk, Stockholm (Sweden)). 1984. 31p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752727.

A simple method for modifying small wood boilers to pellets-firing have been tested on five different furnaces installed in one-family houses in central Sweden. The main modifications are: a reduction of the grate surface through installation of wedge-shape boxes, installation of an angle iron on the grate in order to bypass some of the combustion air and add it as secondary air. The results of combustion tests are given for each furnace. It is concluded the modifications resulted in good systems with high efficiency, although no effort was made to optimize the installations. Recommendations are made for further studies.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 346

1304 Regulations And Licensing

292 **(DOE/RA/04934—2) Small Scale Hydropower Program: legal and institutional aspects project monitor report.** (Franklin Pierce Law Center, Concord, NH (USA). Energy Law Inst.). Sep 1985. Contract AC07-78RA04934. 56p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001434.

This is the final of a series of reports on the regulatory and institutional factors affecting the small scale hydropower industry. The period of time covered by this report is from December 13, 1984 to June 30, 1985. Significant developments have occurred in the hydroelectric regulatory process at both the federal and state level with respect to implementation of Section 210 of the Public Utility Regulatory Policies Act of 1978 (PURPA). FERC developments include the following: The SOFAR project has been licensed under a municipal preference. FERC has issued a methodology for assessing environmental impacts of hydro projects "clustered" on specific river basins across the country. FERC approved issuance of a final rule amending the application procedures for licenses, exemptions and preliminary permits. The greatest number of developments have taken place in the area of state implementation of PURPA.

1305 Economics And Management

293 **(DOE/BP—545) Running the rivers. How the Federal Power System operates in low-water years.** (USDOE Bonneville Power Administration, Portland, OR). Sep 1985. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002018.

The BPA management of the Columbia River and its hydroelectric system is discussed. As a result of BPA actions even though the 1985 summer was one of the driest ones in the basin, power and recreational interests suffered far less than they might have otherwise. (DLC)

1306 Environmental Aspects

294 **(DOE/BP—548) Annual report on resident fish activities. Fiscal Year 1985.** (USDOE Bonneville Power Administration, Portland, OR). Sep 1985. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001917.

This report addresses the status for resident fish projects currently implemented by the Bonneville Power Administration under the amended Columbia River Basin Fish and Wildlife Program. Projects that have been in place for a sufficient length of time are discussed in greater detail with a brief evaluation presented.

295 **(DOE/BP—549) Annual report on wildlife activities, fiscal year 1985.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). Sep 1985. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002022.

The report presents a brief synopsis and discussion of wildlife activities undertaken by Bonneville Power Administration. The objectives of the program were wildlife protection, mitigation, and enhancement planning; and implementation of actions to protect, mitigate, and enhance wildlife affected by development and operation of hydroelectric facilities in the Columbia River Basin. (ACR)

296 **(TVA/PUB—86/1) Oxygenation cost estimates for Cherokee, Douglas, and Norris reservoirs.** Fain, T.G. (Tennessee Valley Authority, Norris (USA). Div. of Water Resources). Oct 1980. 21p. NTIS, PC A02/MF A01. File Number DE86900101.

The capital and annual costs associated with reoxygenation of the turbine releases at Cherokee, Douglas and Norris Reservoirs using the small bubble injection technique developed for Ft. Patrick Henry Dam were computed. The weekly average dissolved oxygen (DO) deficits were computed for each reservoir for an average year (based on 16 years of records). The total annual cost of an oxygen supply and injection system for each reservoir is presented. 5 refs., 6 figs., 5 tabs.

297 **(TVA/PUB—86/2) Oxygenation cost estimates in 1983 dollars for Cherokee and Douglas Dams.** Fain, T.G.; Boyd, J.W. (Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Dec 1983. 13p. NTIS, PC A02/MF A01. File Number DE86900102.

As part of the Reservoir Releases Program, estimates of costs associated with providing high purity oxygen injection systems at Cherokee and Douglas Dams were computed in 1983 dollars. This report presents results of the computations. An 8.125% interest rate, a 25-year economic life, and a 10-year diffuser life were assumed. Weekly average dissolved oxygen concentration (DO) and turbine flowrate data were available for the years 1958 through 1980. 4 refs., 6 figs., 3 tabs.

14 SOLAR ENERGY

298 **Economics of attracting new talent.** Annan, R.H. (U.S. Department of Energy). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1175-1177(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The U.S. photovoltaics industry is rapidly expanding. Because of its high-technology nature, the industry places demands on technical manpower supply. If the U.S. photovoltaics industry is to maintain its world dominance, steps must be taken to insure that these manpower needs, as well as the demand for innovative ideas, are met. This paper explores approaches for attracting more and better technical expertise to photovoltaics. It examines problems facing U.S. education which could lead to the demise of U.S. leadership in all industries. Actions which can be taken by government, industry and academia are also presented.

1401 Resources And Availability

REFER ALSO TO CITATION(S) 403

299 **Effects of volcanic dust clouds on surface insolation.** Spencer, D.W.; Stewart, W. (Albright & Spencer, Madison, Wisconsin). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 889-893(Jun 1983).

Clear periods of days from thirty-one months were used to determine the intensities of direct, global, and diffuse solar radiation at the earth's surface in four spectral bands. The solar measurements were made through Schott filters OG1, RG2, RG8, and WG7 with Eppley Normal Incidence Pyrheliometers and Precision Spectral Pyranometers. The spectral band intensities were calculated by finding the difference between the measurements. The diffuse was calculated by subtracting the direct on a horizontal surface from the global. The dust clouds from both the Mt. St. Helens and El Chichon volcanic eruptions affected the measured intensities in these bands. The effect from the Mt. St. Helens cloud was large but short in duration, while the El Chichon effect was smaller but persistent through several months.

1403 Economics

300 **Active solar energy market trends.** Freidman, D.M.; Mihlmester, P.E. (Applied Management Sciences, Silver Spring, Maryland). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 755-760(Jun 1983).

The analyses presented in this paper summarize the U.S. active solar market shifts or trends as depicted by the 1980 and 1981 market surveys developed for the Energy Information Administration (EIA) of the U.S. Department of Energy (DOE). The trends identified and analyzed represent the first such analyses based on extensive survey data obtained from questionnaires sent out annually to more than 6,000 solar-related firms. National market trends are analyzed predominantly by using three criteria: number of systems installed, collector area installed, and revenue generated at the solar installer level. In addition, market trends are identified and analyzed by the following solar system applications: pool heaters, water heaters, space heaters, and combined space and water heaters.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 261, 262, 263, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 283, 284, 285, 286, 287, 291, 347, 416, 808, 1120, 1128, 1129, 1133, 1398

301 **(DOE/BP/11286—1) Evaluating double entry logging for forest residue recovery in southwestern Oregon.** Brown, L.F.; Craig, L.S.; Buscaglia, P. (Brown (Larry) and Associates, Grants Pass, OR (USA)). Sep 1985. Contract AC79-83BP11286. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001700.

The objective of this research was to compare actual cost and production between conventional logging practices and double entry methods for residue removal in old-growth fir and pine of southwest Oregon using an actual timber sale, to determine and report benefits of the double entry concept to the study cooperators, any uncontrolled variables in the study which could influence the results, and how the order of yarding influences the results; and to compute the cost of logging with the double-entry method, the cost and quantity of the residue removed, and the cost of delivering the fuel to a theoretical cogeneration plant 14 miles from the timber sale. As a result of the study it might be concluded that situations where double entry appears to be cost effective would be those which have a large variation in piece size, require YUM yarding to a 6″ by 8′ or smaller size piece, are on steep terrain, and have an understory with many small unmerchantable logs and residue mixed with the large overstory trees. A similar study in the intermountain region by Leonard Johnson of the University of Idaho found that a 29% increased sawlog recovery was accompanied by a 63% increased gross return per acre and a 58% increased cost per acre. The added cost of double entry did not offset all traditional costs of slash disposal. However, if slash disposal requires yarding of residues, the cost per acre is reduced by the double entry method. Johnson made similar findings of the need to determine most optimum terrain and tree species for the method and to improve the yarder and various loading options. 6 refs., 13 figs., 23 tabs.

302 **(DOE/ER/04310—T4) Primary light harvesting system: the relationship of phycobilisomes to Photosystem I and II. Progress report, September 1983-May 1985.** Gantt, E. (Smithsonian Institution, Rockville, MD (USA). Smithsonian Environmental Research Center). 1985. Contract AS05-76ER04310. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001635.

The association of phycobilisomes, the primary photosynthetic antennae systems in red algae and cyanobacteria, with Photosystem II, previously expected from energy transfer measurements, has now been established. Photosystem-II-phycobilisome particles from the red alga Porphyridium cruentum were isolated. These particles lack photosystem I components, have high O_2-evolution rates, which are sensitive to DCMU and are abolished by 10 mM hydroxylamine. The phycobilisomes were functionally attached, since green light which is absorbed by phycoerythrin was most effective in driving O_2-evolution and 2,6-dichlorophenol indophenol reduction. The majority of the particles appear by electron microscopy to retain small membrane fragments at their base. Selective removal of the phycobilisome components results in the enrichment of a 50 kD polypeptide which is considered to be the putative photosystem II reaction center. 14 refs.

303 **(DOE/ER/13187—2) Particulate models of photosynthesis. Progress report.** Seely, G.R. (Battelle-Charles F. Kettering Research Lab., Yellow Springs, OH (USA)). Oct 1985. Contract FG02-84ER13187. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001625.

Studies are reported on the photochemical and physical properties of chlorophyll while associated with various surfactants onto polyethylene particles. Results to date have shown that the forms of chlorophyll association are specific to the surfactant; furthermore, when chlorophyll is ligated by the surfactant, even dense associations are fluorescent, but when the ligating surfactant contains a reducible group like quinone, the fluorescence is strongly suppressed. 9 refs., 10 figs., 2 tabs.

304 **(DOE/JPL—954527-27/85) Investigation of test methods, material properties, and processes for solar cell encapsulants. Ninth annual report.** Willis, P.B. (Springborn Labs., Inc., Enfield, CT (USA)). 1985. Contract NAS-7-100-954527. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001309.

Progress is reported in the areas of: aging and life prediction methodology and devices for solar cell encapsulation; the function of adhesion chemistry, primers, and a new diagnostic technique for estimations of bond durability; a study of fire retardant formulations for decreasing the potential flammability of solar modules; initial studies of the electrical insulating properties of encapsulation materials and measurement of the intrinsic dielectric strength; anti-soiling compounds for the prevention of soil build-up on the outer surface of the module; and low temperature processing encapsulants that permit module fabrication at temperatures less than 100°C. Another area of study has been added to determine the degree to which formulation and processes affect the module quality and manufacturing yield.

305 **(DOE/R1/10059—T1) Multimodal solar collector. Final report.** (McClintock (Michael), Boston, MA (USA)). Mar 1982. Contract FG41-79R110059. 20p. (MA—79-003). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000356.

Experimental apparatus was constructed and observations made on a solar collector designed to produce both electricity and heat from the sun. Results were negative. Although the data show the idea to be sound, it will be necessary to find liquids with superior characteristics to those used in order to achieve positive results.

306 **(ERDA/JPL/1012—76/1) First Task Integration Meeting: proceedings.** (Jet Propulsion Lab., Pasadena, CA (USA)). Jan 1976. Contract AI01-76ET20356. 355p. (CONF-760179—Summ.; JPL/D—5101-2). NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85015765.

From 1. Low-cost Silicon Solar Array (LSSA) task integration meeting; Pasadena, CA, USA (13 Jan 1976).

The primary objectives of the meeting reported were: to provide an overview of the Low-Cost Silicon Solar Array (LSSA) Project technical plans, progress, and problems, and to further identify and establish the technical interfaces within and between project tasks. This document includes summaries of the task sessions as presented by each task manager during the review. It consists of the vugraphs used in the presentations, a brief summary from each contractor, and a brief summary of the meeting. (LEW)

307 **(ERDA/JPL/1012—76/4) Low-Cost Silicon Solar Array Project. Proceedings of the second project integration meeting. Summary.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1976. Contract AI01-76ET20356. 239p. (CONF-7604175—Summ.; JPL/D—5101-5). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85015771.

From 2. Low-cost Silicon Solar Array (LSSA) project integration meeting; Pasadena, CA, USA (27 Apr 1976).

The primary objectives of the meeting reported were to integrate the Low-Cost Silicon Solar Array (LSSA) Project technical plans and activities, to further identify and establish the technical interfaces, and to provide an overview of project technical plans and status. Summaries are included of task sessions as presented by each task manager, covering work on silicon material, large-area silicon sheet, encapsulation, array automated assembly, and large-scale production. The document includes vugraphs used in the presentations, technical progress summaries from the contractor, and a brief summary of the meeting. (LEW)

308 **(EUR—9867-EN) Production of solar cells on the basis of low cost silicon by application of ion implantation and light-induced transient heating.** Nylandsted Larsen, A.; Drud Nielsen, L. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 87p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The aim of the present work has been an experimental investigation of some advanced methods for preparation of low cost silicon pn-junction solar cells. The original project proposal comprised the application of ion implantation - with and without mass separation. The actual project has diverged from this plan by inclusion of the new and very promising similar techniques where laser processing has been substituted by short-duration incoherent-light exposure from a xenon arc lamp. Boron and boron-fluoride implantations have been studied after furnace annealing, neodymium-laser annealing, and incoherent-light annealing. Incoherent-light annealing also takes advantage of the fluorine content, due to its amorphizing effect, but perfect annealing, with simultaneous preservation of bulk properties, has apparently not been achieved. Xenon-lamp annealing has further been studied for removal of damage after conventional implantation of arsenic, antimony, and phosphorus. Arsenic implantation has been investigation in greatest detail, due to the possibility of profiling by Rutherford backscattering techniques. Phosphorus implantation, however, has been most successful with solar cell fabrication in mind, because of a lower annealing temperature. Laser induced arsenic diffusion has been carried out from spun-on coatings of a commercial arseno-silica emulsion, however with utilization factors as low as 0.4%. Higher yields (up to 30%) were achieved with diffusion of antimony from deposited antimony-chloride films. Finally, incoherent-light induced diffusion of arsenic and phosphorus has been studied extensively. Best results were obtained with phosphorus diffusion from spin-on deposited phosphoro-silica films.

309 **(JPL—5101-18) Low-Cost Silicon Solar Array Project. 5th project integration meeting. Summary.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1977. Contract AI01-76ET20356. 94p. (CONF-770168—Summ.). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85015770.

From 5. Low-cost Silicon Solar Array (LSSA) project integration meeting; San Diego, CA, USA (17 Jan 1977).

The objective of the Low-Cost Silicon Solar Array (LSSA) Project is to focus its activities on the development and procurement of solar cell arrays that are compatible with photovoltaic power systems which have minimum system life-cycle costs. Results are briefly summarized for each task, including tasks on silicon material, large-area silicon sheet, encapsulation, automated array assembly, large scale procurement, operations, and engineering. A record of each of the detailed presentations given is provided by a series of vugraphs used during the proceedings. (LEW)

310 **(JPL—5101-29) Low-Cost Silicon Solar Array Project.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1977. Contract AI01-76ET20356. 97p. (CONF-7705203—Summ.). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85015769.

From 6. Low-cost Silicon Solar Array (LSSA) project integration meeting; Pasadena, CA, USA (4 May 1977).

A special review of ingot technology in the light of interim cost goals was conducted at this meeting, as well as the normal task-level reviews, inter-task sessions, and general discussions. The established agenda for the two days' meeting is given. In general, the status of Project activities and progress toward interim and 1986 goals appeared satisfactory. In the special session, strong interest was centered around concepts associated with early-achievable low-cost ingot growth and slicing. Other subjects of interest in this discussion included cost reduction for silicon material, speculations regarding future large-scale government-supported module markets, and the economics of projected large-scale low-cost processing. Other subjects discussed in various large sessions included the modeling of module service operations and maintenance; module design and test requirements; testing operations and results; and the effects of material impurities on cell performance. Special presentations included a discussion of photovoltaics market analysis and an outline of plans for the Solar Energy Research Institute.

311 **(JPL—5101-37) Low-Cost Silicon Solar Array Project. 7th project integration meeting. Summary.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1977. Contract AI01-76ET20356. 82p. (CONF-7708131—Summ.). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85015768.

From 7. Low-Cost Silicon Solar Array (LSSA) project integration meeting; Pasadena, CA, USA (10 Aug 1977).

A special review of progress relative to the goal of $2/watt was conducted, as well as task-level reviews in silicon material, large-area silicon sheet, encapsulation, and automated array assembly tasks. Viewgraphs used in presentations on preliminary manufacturing cost estimates for mass production of solar arrays are given, as well as viewgraphs presented in discussions of general interest. (LEW)

312 **(JPL—5101-52) Low-Cost Solar Array Project. 8th project integration meeting. Summary.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1977. Contract AI01-76ET20356. 232p. (CONF-771299—Summ.). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85015767.

From 8. Low-Cost Solar Array (LSA) project integration meeting; Pasadena, CA, USA (7 Dec 1977).

Viewgraphs are given that were used in presentations of a uniform costing methodology applied to the $2/watt goal technology and of the input data description formats and Interim Price Estimation Guidelines equations. Viewgraphs are also provided to document presentations in the various task areas: silicon material, large-area silicon sheet, encapsulation, production process and equipment, engineering, and operations. (LEW)

313 **(ORNL/TM—9576) BIOCUT: a microcomputer based economic evaluation model for wood energy plantations. Model description and users guide.** Das, S.; Perlack, R.D.; Barron, W.F.; Kroll, P. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001371.

Increasing demands for fuelwood and wood energy feedstocks has placed severe pressures on forest resources in many developed and developing countries. Energy plantations are one concept under investigation for increasing the size and productivity of the wood resource base. The BIOCUT model described in this report is designed to facilitate the systematic investigation of a wide range of potential wood energy plantation applications and to provide reasonable estimates of net returns and minimum required product prices. There are five user-specified sets of input data in the BIOCUT model: (1) plantation scenario activities, (2) economic parameters, (3) plantation establishment activities, (4) operation and maintenance activities, and (5) harvesting, processing, and transportation. The BIOCUT model reports yearly information on the economic status of the plantation, cash-flows, and the age distribution of the standing biomass. The model calculates the net present value, the discounted average cost, internal rate of return, and benefit-cost ratio. Because of the high degree of uncertainty surrounding important biological and economic relationships, the model facilitates extended sensitivity analysis. Further, if upper and lower bounds can be defined for each important variable, the model can also be used to conduct a risk analysis. The risk analysis uses the parameters of the probability distribution rather than the distribution itself to construct the mean and variance of the net present value. With this information probability statements can be made about achieving various levels of net present value. The BIOCUT model is coded in PASCAL and operates on IBM personal computers and compatibles with 256K memory using the DOS 2.0 operating system.

314 (SERI/CP—251-2680, pp 149-155) **Thermoelectrochemical (TECH) system research.** Ludwig, F. (Hughes Aircraft Co., El Segundo, CA). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

ThermoElectroChemical cycle (TECH) is a heat engine in which heat is absorbed at an upper temperature and rejected at a lower temperature. The electrochemical cell receives a reactant at each electrode. These reactants become products as DC electric power is generated. The products then are thermally regenerated to the original reactants at the other temperature. Electrochemical cell and thermal regenerator can be at either the upper or lower temperature. Many schemes have been devised in the last 30 years. Nearly all of these TECHs have not been of major significance because they lacked high power density, high conversion efficiency or operational simplicity. The sodium heat engine has been the one exception which has proven that the conceptual advantages of

TECH systems are realizable. The thermodynamic criteria for this heat engine are discussed.

315 **(SERI/STR—211-2755) AlGaAs-GaAs patterned Ge tunnel junction cascade concentrator solar cell. Annual technical progress report, 15 October 1983-14 December 1984.** (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1985. Contract AC02-83CH10093. 92p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85016856.

The goal of this research is to demonstrate a two-junction cascade solar cell, 0.5 cm^2 in area, in the AlGaAs-GaAs material system that has a power conversion efficiency of more than 30% at a cell temperature of 50°C. Objectives for the first year of the program included growth of Al/sub x/Ga/sub 1-x/As on Al/sub y/Ga/sub 1-y/As exposed to air for at least one hour; growth of Ge by vapor phase epitaxy on a GaAs substrate; fabrication of a p/n patterned Ge tunnel junction grown on n-GaAs and demonstration of a current density larger than 80 A/cm^2; growth and characterization of a top cell on a patterned Ge tunnel junction; and fabrication and demonstration of an AlGaAs-GaAs cascade solar cell using the patterned Ge tunnel junction. A patterned Ge-tunnel junction connecting the n-type base region of a GaAs cell to a p^+-GaAs substrate was demonstrated for the first time.

316 **(SERI/STR—211-2756) Research on basic understanding of high efficiency in silicon solar cells. Final subcontract report.** Wolf, M. (Pennsylvania Univ., Philadelphia (USA). Moore School of Electrical Engineering). Aug 1985. Contract AC02-83CH10093. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85016858.

Through modelling of silicon solar cell performance, a solar cell design has evolved that could reach efficiencies above 20% (AM1) under standard conditions. Modeling has been based on current understanding of the effects involved in charge carrier generation, transport, and recombination, and on technology-influenced parameters already reported as achieved. It is also important to experimentally determine the values for all parameters used in modelling the device. However, experimental methods for determining physical parameters, particularly minority carrier lifetimes and surface recombination velocities, are still inadequate. A goal of solar cell research has therefore been to develop adequate analytical methods to determine all parameters of a device that affect its performance. This project has contributed to that goal by investigating a "closed loop design" capability. Based on previous modelling, which resulted in a device design, a developmental fabrication process sequence was also designed. Next, devices were fabricated using the process design. When the devices were completed, their performance was measured, and the relevant device parameters determined. Measured data were compared to the design values and related to both measured and expected performance. Several modifications were then made to the original process sequence. The cell design being pursued appears to be sound.

317 **(STEV-EO—85-3) Areas for energy forestry in Sweden.** Lindroth, S.; Aakerblom, K. (Statens Energiverk, Stockholm (Sweden)). Aug 1984. 160p. (In Swedish). (SLU-IST—36). NTIS (US Sales Only), PC A08/MF A01. File Number DE85752738.

National Swedish Energy Administration initiated the project 'Inventory of Land for Energy Foerstry' at the Department of Forest Survey at the Swedish University of agricultural Sciences. This report presents the results of the project, which ended in spring 1984. The object of the project was to determine the extent of areas for energy forestry and the situation of these areas as well as the restrictions limiting their use for Energy Forestry. To sum up we can state the following conclusions: 1. The total amount of land in Sweden where it is possible to cultivate energy forest is high - ca 4 million hectares or 10% of the total land area fulfill the basic criteria of Energy Forest land. 2. Present land use considerably limits the utilization of the gross areas. This is the case especially on forest land and on agricultural land. 3. The miscellaneous land types are of minor importance. Only a few thousand hectares are available. 4. Unproductive peat land appears to be the major land potential. However, the costs for these areas are high, implying that the potential can be decreased severely. 5. Through planning and legislation, the areas for Energy Forestry can be increased considerably, since the present planning restriction are the most limiting factor. 6. If clones of the tree species in question could be produced, which are more resistant to climatic conditions and dryer soils, considerable areal contributions can be made. 7. The available areas seem to be less than earlier investigations indicate. This is especially the case if economic factors are considered.

318 **(TVA/ONRED/LER—85/25) Biomass analyses for four areas in the Tennessee Valley Authority.** Perry, J.D. (Tennessee Valley Authority, Norris (USA). Div. of Land and Economic Resources). Apr 1985. 31p. NTIS, PC A03/MF A01. File Number DE86900096.

Analyses for four biomass procurement areas in the Tennessee Valley are presented. The Marlow and Perryville, Tennessee, sites can provide 38,000 dry tons of industrial residue annually. Mulberry Creek, Alabama, and Watts Bar, Tennessee, can annually provide 330,000 dry tons of industrial residue and/or forest biomass. Methanol can be produced at the Perryville and Marlow sites and ethanol at Mulberry Creek and Watts Bar. 5 figs., 9 tabs.

319 **Water hyacinth biomass production in eutrophic lake water.** Reddy, K.R.; DeBusk, W.F.; Bagnall, L.O. (Univ. of Florida, IFAS Central Florida Research and Education Center). pp 630-644 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Preliminary results on biomass yield, harvesting, and handling of water hyacinth (Eichhornia crassipes) cultured in eutrophic Lake Apopka water are presented. Annual biomass yields of water hyacinth were about 42 mt/ha.yr with about 4.6% of total yield produced in January-February, 7.4% in November-December, 16% in September-October, 21% in March-April, and about 51% in May-August. Harvesting strategies were proposed to supply a constant amount of biomass to the methane digestor throughout the year. Three harvesting systems are being explored for application to the open lake environment: a mobile system, an immobile system, and a hybrid system. Potential advantages and limitations of these harvesting systems are discussed.

320 **Principles and technology of biomass gasification.** Reed, T.B. (Solar Energy Research Inst., Golden, CO). pp 125-174 of Advances in solar energy: an annual review of research and development, vol. 2. Boer, K.W.; Duffie, J.A. New York, NY; Plenum Press (1985).

After a dormant period following World War II, biomass gasification entered a period of rapid development. The major types of gasifiers and their various modes of operation are discussed. The role of thermodynamic equilibrium and kinetics in gasifier operation is presented. The mechanisms and kinetics of pyrolysis and char gasification are reviewed and the current state of gasifier modeling is surveyed.

321 **Mechanical proof testing in cell processing.** Chen, C.P.; Liepold, M.H.; Ross, R.G. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1384-1385(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Fracture mechanics test methods are applied to evaluate the proof test characteristics of silicon Cz wafers. The results indicate that the strength distribution of silicon wafers is truncated by proof testing and no subcritical crack growth in silicon is observed during proof loading. Mechanical proof testing appears to be an effective method to eliminate weak samples before cell processing.

322 **Use of instantaneous load data in predicting PV system performance.** Collaros, G.J.; Enlow, E.W. (The BDM Corporation, Albuquerque, New Mexico). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1055-1059(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

In the past, predictions of PV system performance had to rely on models which used hourly timeaveraged load data. The consensus of opinion prior to this program was that use of hourly timeaveraged data to simulate the annual performance of a PV system in a residential application would lead to large errors in calculating the amount of energy supplied to a load, and that instantaneous load data was required to properly size a system to meet demand and to determine the system's economic worth. A large data base of continuously monitored load data, measured at 5-second intervals on four residences in three regions of the country, was accumulated during this study. After the data was statistically characterized, an algorithm was developed and incorporated into SOLCEL for annual performance simulations. Calculating PV performance using real, instantaneous load data over a range of load activity and array sizes produced no significant effect.

323 **Origin of defects in CdS films associated with degradation of Cu_xS/CdS solar cells.** Shea, S.P.; Birkmire, R.W.; Meakin, J.D. (Institute of Energy Conversion, University of Delaware, Newark, Delaware). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1270-1275(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Growth defects in CdS films which can result in shunts in Cu_xS/CdS solar cells, were found to originate on flaws in the substrate material and on foreign materials adhering to the substrate. The primary source of these foreign materials have been identified as insulation used in the CdS evaporator, fibers from the CdS source powder, and particulates present in the deionized water used in substrate cleaning. These results illustrate that the problems which must be addressed in order to produce a reliable Cu_xS/CdS solar cell are neither fundamental nor particularly exotic.

324 **Performance and interface studies of SnO /SUB x/ :Sb/Si solar cells.** deOliveria Cruz, L.R.; Dhere, N.G.; Dhere, R.; Dick, J.R.; Kazmerski, L.L.; Swartzlander, A.B. (Instituto Militar de Engenharia, Rio de Janeiro). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1259-1262(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The layer composition, interfacial chemistry, and performance of sprayed, antimony-doped SnO /SUB x/ /Si solar cells are investigated. The devices and interfaces were examined by Auger electron spectroscopy and secondary ion mass spectrometry for composition and impurities. Electrical and metallurgical junction location has been established by complementary EBIC and Auger voltage contrast. Higher efficiency solar cells are fabricated at higher SnO /SUB x/ :Sb processing temperatures. This is attributed to the lower Cl content of the films, higher Sb content leading to decreased layer resistivity, a diminished Sb accumulation at the junction, and a thinner, better defined SiO /SUB x/ transition region.

325 **Effective monatomic hydrogen diffusion constants in polycrystalline silicon.** Ginley, D.S.; Hellmer, R.P. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1213-1217(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The passivation of grain boundaries in polycrystalline silicon with monatomic hydrogen has demonstrated considerable potential for improving thin film and ribbon solar cell efficiencies. Very little is known of the chemistry and kinetics of this process. The authors demonstrate here a technique which allows an estimation of the monatomic hydrogen diffusion constant for grain boundary diffusion in bulk polycrystalline silicon. They observe a diffusion rate for grain boundaries in the bulk material comparable to that observed previously for individual boundaries. The authors also observe a near surface enhanced passivation rate which can be effectively modeled by the incorporation of a second diffusion constant into the diffusion equation.

326 **Mechanisms limiting open circuit voltage in silicon solar cells.** Spitzer, M.B.; Keavney, C.J.; Lindholm, F.A.; Nevgroschel, A.; Tobin, S.P. (Spire Corporation). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1218-1224(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

This paper reports the results of research on mechanisms limiting open circuit voltage in conventional p/n junction silicon solar cells, with a view toward both the understanding of various heavy-doping effects and the achievement of high conversion efficiency. Experimental and theoretical studies have been conducted in order to correlate heavy-doping effects to actual solar cell performance. The experiments have utilized a variety of emitter configurations with various doping concentrations in order to emphasize a number of concentration-dependent mechanisms. The theoretical modeling addresses the determination of both recombination velocity at the passivated front surface and effects of recombination at the front ohmic contact.

327 **Conceptual error in the calculation of the AM1 short circuit current from light biased spectral quantum efficiency measurements.** McMahon, T.J.; Konekamp, R.; Sadlon, K. (Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1225-1228(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The authors point out a conceptual error in the calculation of the AM1 short circuit current of solar cells whose current response is not a linear function of photon flux where the generally accepted procedure is to use AM1 light biased quantum efficiency data. Such an error can be minimized if the cell is placed under a d.c. light bias of 0.37 AM1 irradiance. Finally, data showing departures from linearity on a crystalline Si cell and on several a-Si cells is presented.

328 **$CuInSe_2$/CdS-CdTe/CdS polycrystalline tandem solar cells.** Birkmire, R.W.; DiNetta, L.C.; Meakin, J.D.; Phillips, J.E. (Institute of Energy Conversion, University of Delaware, Newark, Delaware). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1406-1407(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

A monolithic optically and electrically coupled tandem junction has been produced. The component cells are $CuInSe_2$/CdS and CdTe/CdS polycrystalline heterojunctions. A 3% efficient device with over 1.0 volt open circuit voltage and 6 mA/cm^2 short circuit current has been achieved. It is estimated that an efficiency of over 20% should be practically achievable.

329 **Photoluminescence studies of $CuInSe_2$.** Abou-Elfotouh, F.A.; Dunlavy, D.J.; Hermann, A.M.; Kazmerski, L.L. (Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1410-1411(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The chalcopyrite ternary compound $CuInSe_2$ is receiving considerable technological interest as a recognized and strong candidate for photovoltaic application. Cd(Zn)S/$CuInSe_2$ heterojunction cells have attained conversion efficiencies near 11%.[1-2] The basic electrical and optical properties of $CuInSe_2$ have been investigated[3-5] as functions of the growth and annealing conditions, and have been correlated, in some cases, with the resulting device performance. The presence of both intrinsic and extrinsic defects have been shown to control these fundamental electro-optical properties. The purpose of this paper is to investigate and identify such de-

fects, and the effects of various processing on them. For the first time, the energy states of these defects are reported for both n- and p-type $CuInSe_2$ films and crystals as functions of the processing conditions. In this work, high-resolution photoluminescence (PL) spectra were obtained as functions of temperature for $CuInSe_2$ crystals (melt grown by the gradient freezing method), and thin films (vacuum deposited by the three source technique). Detailed energy band representations of n- and p-type $CuInSe_2$ have been developed. For the first time, the energy location of the various defect states have been determined using photoluminescence, fully-consistent with previous electro-optical investigations.

330 **Material requirements for high efficiency $CuInSe_2$/CdS solar cells.** Birkmire, R.W.; Hall, R.B.; Phillips, J.E. (Institute of Energy Conversion, University of Delaware, Newark, Delaware). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 882-886(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

$CuInSe_2$/CdS solar cells with efficiencies greater than 8% have been made by the elemental evaporation of $CuInSe_2$ onto Pt and Mo contacts. Both Pt and Mo can give I-V characteristics which show a 'second diode blocking contact' in the completed cell. The 'second diode' behavior does not appear to affect the final device efficiency. In-doped high conductivity CdS was usually evaporated onto the $CuInSe_2$ to make the final device. High conductivity CdS was used to ensure that most of the depletion layer would be in the $CuInSe_2$ thereby aiding in the collection of minority carriers and giving a diode quality factor close to unity. Other devices have been made over a range of CdS conductivities in order to increase understanding of junction behavior.

331 **A vapor transport, Filtration technique for purifying silicon.** Olson, J.M.; Powell, R. (Solar Energy Research Institute, Golden, CO). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1143-1145(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

We have recently developed a Vapor Transport, Filtration (VTF) technique for purifying metallurgical grade silicon that has yielded in a single step a 99.9999^+ % pure silicon in a dense, coherent form. The technique is a modification of closed-cycle, hot-filament process using HCl as a transport gas. The silicon source is a two phase composite of silicon embedded in a Cu_3Si matrix, and the purified silicon is deposited from the vapor phase onto a hot, silicon filament. The purification mechanism is a combination of the expected segregation of certain impurities associated with the vapor transport process and the diffusional trapping of impurities within the bulk of the composite source. The net result is that essentially all impurities are effectively segregated. The refined material is typically n-type with a resistivity of 0.1-1 ohm-cm and yields solar cells of 9.6% relative to a baseline of 9.6% (with no AR coating).

332 **Hydrogen passivation of electrically active defects in crystalline silicon solar cells.** Milstein, J.B.; Osterwald, C.R.; Tsuo, Y.S.; White, E.W. (Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1127-1132(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

In this study, the authors have observed significant improvements in the efficiencies of dendritic web and edge-supported-pulling (ESP) silicon sheet solar cells after hydrogen ion beam passivation for a period of ten minutes or less. They have studied the effects of the hydrogen ion beam treatment with respect to silicon material damage, silicon sputter rate, introduction of impurities, and changes in reflectance. They have determined that the silicon sputter rate for a constant ion beam flux of 0.60 + or - 0.05 mA/cm^2 exhibits a maximum at approximately 1400 eV ion beam energy. They have observed that hydrogen ion beam treatment can result in a reduced fill factor, which is caused by damage to the front metallization of the cell rather than by damage to the p-n junction.

333 **Research on photoelectrochemical cells based on CdSe, CdSe /SUB 1-x/ Te /SUB x/ and other photoelectrode materials.** Wallace, W.L. (Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 916-920(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Research on electrochemical photovoltaic cells incorporating thin film n-CdSe and n-CdSe /SUB 1-x/ Te /SUB x/ photoanodes has resulted in efficiencies up to 7.5% using small area electrodes in polysulfide electrolytes. Efficiencies close to 10% can be achieved using alternate electrolytes in significantly less stable systems. The major limitations on the efficiency of II-VI photoelectrochemical cells are associated with the open circuit voltage and the fill factor. Research on $CuInSe_2$ electrochemical photovoltaic cells has resulted in efficiencies up to 11.7% using single crystal n-$CuInSe_2$ photoanodes in aqueous electrolytes. The n-$CuInSe_2$ surface and the electrolyte have been optimized to produce a highly stable semiconductor/electrolyte junction. A review will also be given on the status of photoelectrochemical storage cell research. Photoelectrochemical measurement techniques have been used to probe the semiconductor/electrolyte interface and have been used to support the characterization of semiconductor materials for solid state photovoltaic applications.

334 **DOE/SERI polycrystalline thin-film photovoltaic research.** Hermann, A.; Mitchell, R.; Zwelbel, K. (Solar Electric Conversion Research Division, Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 910-915(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

This paper presents recent results, status, and future prospects for the U.S. Department of Energy's (DOE's) Polycrystalline Thin Film Photovoltaic Program, managed by the Solar Energy Research Institute (SERI). The devices being studied most intensively are heterojunctions based on $CuInSe_2$ and on CdTe. Both materials have attained over 10% efficiency in polycrystalline form. The main emphasis is on $CuInSe_2$, for which Boeing has reported an 11%-efficient device (AM) ELH simulation). Important work is being done on studies of the composition/electronic properties of $CuInSe_2$ and its response to post-deposition annealing. In the CdTe research, ohmic, stable back-contacting and control of p-type doping are being investigated. New efforts to study polycrystalline two-junction stacked cells are underway with two-terminal cells (at IEC) and with four-terminal cells (at SMU). This preliminary work is expected to be expanded, with emphasis on CdTe and other top-cell (high-bandgap) materials. These efforts introduce a number of new research areas (e.g., transparent ohmic contacts to p-CdTe and sub-bandgap light-losses in polycrystalline materials). The aim of the program is to produce stable, high-efficieny (15%), thinfilm cells that can be deposited inexpensively by techniques that are scalable to large areas.

335 **CdS/$CuInSe_2$ heterojunction cell research.** Noufi, R.; Axton, D.; Cahen, D.; Deb, S.K. (Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 927-932(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The objective of this research is to fabricate and characterize $CuInSe_2$ thin films and to fabricate and characterize CdS/$CuInSe_2$ solar cells. The material can be deposited either n- or p-type with mobilities of up to 150 cm^2/V s and carrier concentrations ranging from 10^{15}-10^{20} cm^{-3}. X-ray diffraction reveals a single phase with strong preferred orientation along <211> and <112> directions. The basic device structure of the cell consists of two $CuInSe_2$ layers, varying in the stoichiometry of elements and electrical prop-

erties, and two layers of CdS. Composition studies as well as electrical property measurements of the two layers were carried out to illustrate the role of the two layers of $CuInSe_2$. The methods used and results are discussed in detail and a conclusion is drawn as to whether the two layers in an actual device can be eliminated by using a single layer of intermediate composition and electrical properties.

336 **Research directions and progress in the SERI Advanced High Efficiency Concept Program.** Cole, L.A.; Benner, J.P. (Solar Electric Research Division, Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 952-954(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The inherent electro-optical properties of gallium arsenide (GaAs) and related III-V compounds make this class of semiconductors an optimum choice for use in very high efficiency solar cells. The ability to alloy GaAs with other column III and V elements while maintaining the single crystal zincblende structure allows the photovoltaic properties to be tailored to specific needs. The current understanding and control of the properties of these materials is more advanced than for any other semiconductor except single crystal silicon. For these reasons, the Advanced High Efficiency Concepts Program supports materials research to improve the properties of III-V semiconductors needed to achieve the maximum attainable photovoltaic conversion efficiencies.

337 **Solar spectrum influence on the annual performance of ALGaAs/Si stacked cells.** King, D.L.; Siegel, R.B. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 944-951(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

An analytical model for calculating the annual performance of mechanically stacked multibandgap solar cells has been developed. This capability was used to investigate the potential performance of AlGaAs on Si stacked cells under concentrated sunlight. For series connected cells, the optimum AlGaAs bandgap was found to be approximately 1.75 eV. For independently connected cells, AlGaAs bandgaps from 1.42 to 1.90 eV were near optimal. For a 1.75 eV AlGaAs cell, the annual penalty resulting from series connection to a silicon cell was found to be minimal (<3%). An annual efficiency of over 40% was calculated for ideal optical and cell performance parameters. However, for cell parameters and optical losses typical of current technology, the calculated annual efficiency was approximately 25%.

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338 **(SERI/SP—271-2728) Photovoltaic stand-alone applications reading list.** (Solar Energy Research Inst., Golden, CO (USA)). Aug 1985. Contract AC02-83CH10093. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008811.

This list of general publications on photovoltaic stand-alone applications was prepared by the Technical Information Branch at the Solar Energy Research Institute (SERI) for the US Department of Energy (DOE) as part of the Solar Technical Information Program. The list provides an introduction to this literature and is not intended to be comprehensive. Although some of the citations refer to grid-connected photovoltaic systems, they contain basic information applicable to stand-alone applications. Many of the technical reports in this reading list result from government contracts with the Jet Propulsion Laboratory, Sandia National Laboratories-Albuquerque, and the Solar Energy Research Institute, or subcontracts from these laboratories to universities and researchers in private industry.

339 **Development and operation of the prototype photovoltaic residential systems at the Southeast Residential Experiment station.** Atmaram, G.H.; Kilfoyle, D.; Ventre, G.G.; Wedekind, D. (Florida Solar Energy Center, Cape Canaveral, Florida). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1323-1328(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The Photovoltaic Southeast Residential Experiment station (SE RES) project, sponsored by the U.S. Department of Energy, began operation in September 1982. As a major part of this project, three prototype utility-interactive photovoltaic residential systems were constructed at the Florida Solar Energy Center (FSEC) in Cape Canaveral, Florida. They became operational in November 1983. Primary consideration was given to investigating a variety of state-of-the-art subsystems (arrays and power conditioners), simplifying array installation and reducing cost. This paper will delineate the development and operational experience gained to date.

340 **Verification of photovoltaic system modeling codes based on system experiment data.** Menicucci, D.F.; Biringer, K.L.; Fernandez, J.P.; Fuentes, M.K. (New Mexico Engineering Research Institute, University of New Mexico). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1335-1341(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The ability to predict system performance is important to the design, testing, and economic evaluation of a photovoltaic (PV) system. Of the many performance models available, little effort has been devoted to assessing their accuracy. This paper describes a verification effort to quantify the accuracy of the PV F-Chart and SOLCEL-II performance models based on field data. These models were selected because of their widespread availability, past use, and complete documentation. The PV F-Chart model is a simple microcomputer code designed to predict long-term performance for planned PV systems. The SOLCEL-II model is a more complex model, requires hourly input data, and is most applicable for use by engineers in evaluating an existing PV system. This effort confirms that both models meet their design objectives.

341 **Thermal modeling of residential photovoltaic arrays.** Mertens, R.; Cheek, G.; Eyckmans, M.; Van Overstraten, R. (Sandia National Laboratories, Albuquerque, New Mexico). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1341-1346(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

To better predict and evaluate the thermal behavior of photovoltaic arrays, a study has been initiated to predict the operating cell temperatures of various systems existing today. This effort is complete on five prototypes at the Southwest Residential Experiment Station (SW RES). These prototypes encompass the widest range of residential photovoltaic designs, and their temperature responses have been modeled to near the tolerance error of the measuring instruments. The arrays include a direct mount, rack mount, integral mount, and two standoff mounts. This study has concluded that the thermal response of the integral, standoff, and rack mounting designs of the Tri-Solar, BDM, and TEA prototypes are thermally equivalent. Furthermore, the direct mount of the GE prototype operates 14° to 18°C hotter than the others. Otherwise, the rest of the thermal difference between the prototypes is a result of the different module designs.

342 **Interaction of residential photovoltaic systems with utility power waveforms.** Tausch, H.J.; Collaros, G.J. (The BDM Corporation, Albuquerque, New Mexico). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1242-1245(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

One of the major items of concern in a photovoltaic/utility interactive system is the effect on utility waveforms. Current and voltage waveforms were measured at the Southwest Residental Experiment Station, which contains 8 PV residential prototypes all serviced by the same utility transformer. The measurements were used to generate and verify a model of the utility/PV system interaction. The effects on utility waveforms were compared to normal residential appliance usage. A simple noise model easily predicted the amount of waveform distortion observed during the tests. The measured data shows that the utility dominates the voltage waveform with the primary effects being observed in the current waveform. However, the current noise is on the same order of magnitude as that generated by normal residential loads.

343 **Photovoltaic power-conditioning performance evaluation, lessons learned.** Bower, W.I.; Key, T.S.; Petterson, B.J. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1252-1258(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

A detailed evaluation of photovoltaic power conditioners has identified critical design characteristics. The units being tested are for single-phase grid-connected applications. The overall performance of recent prototypes is excellent; however, exposure to extreme physical and electrical environments has pointed out some weaknesses. In most cases the weaknesses are not inherent to the designs and can be corrected, once discovered. This paper presents a set of "lessons learned" that highlights the best design aspects and the common problem areas found in PCS hardware. Areas evaluated include utility interface and array interface compatibility, temperature extremes, emanations by and impingements on the unit, maintainability, and reliability.

344 **Assessment of power conditioning for photovoltaic central power stations.** Chu, D.; Key, T.S. (Sandia National Laboratories Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1246-1251(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Results of power conditioning subsystem (PCS) research and development for central station photovoltaic (PV) applications are presented. New circuit designs, advanced power semiconductor devices, and improved packaging techniques coupled with production volume can reduce PCS costs per kilowatt by a factor of four. PV array field modularity offers several options in central station PCS power and voltage ratings. Development potential for two size PCS ranges, 50-500kW and 1-10MW, are examined and compared.

345 **The effect of photovoltaic systems on utility operations.** Thomas, M.G.; Anderson, P.M.; Jones, G.J.; Stevens, J.W. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1129-1133(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The introduction of photovoltaic generation into the grid can potentially affect the utility's power control system. A computer simulation has been used to study the effects of large photovoltaic system operation on utility automatic generation control. Potential problem areas are identified and mitigating operational strategies are proposed.

346 **Photovoltaics, wind and small hydro power generation: comparative costs and performance.** Kern, E.C. (Massachusetts Institute of Technology, Northeast Residential Experiment Station, Concord, MA). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1196-1201(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

While comparison of PV systems cost and performance with the costs associated with utility generation can determine the economic viability of a photovoltaic application, wind and hydroelectric systems are likely to be the competition for investments for either of the two large markets for PV systems. These appear now to be the "third-party" tax shelter type systems which are designed and financially packaged primarily to suit the investment needs of high tax bracket individuals, and systems designed to provide renewable energy to individual homes. The wind system and photovoltaic system research communities have both followed similar paths to assess the markets for their technologies, and to improve their prospects through improving systems performance and taking measures to reduce systems cost. Small hydroelectric systems are a more mature technology, and are more restricted by the numbers of potential sites and, significantly, by interveners in the licensing procedures that have evolved over many years of state and federal regulation. A new approach to assessing the market potential for residential PV systems based on geographic and income distributions of families is used. Results indicate the potential residential market for PV and wind to be about eight million systems.

347 **Recent developments in photovoltaics.** Stone, J.; Flaim, T.; McConnell, R.; Ritchie, D.; Surek, T.; Witt, E. (Solar Energy Research Institute, Golden, Colorado). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1178-1183(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

In this paper the authors describe the long-term (late 1990s) cost and efficiency goals of the recently issued National Photovoltaics Program Five-Year Research Plan, technical goals which are based on a constant dollar electricity cost target of 6.5 cents/kWh. They next discuss an assessment using material requirements for estimating the potential of different PV technologies to meet these goals. This assessment suggests that thin-film PV technologies, especially amorphous silicon, have much potential for achieving the long-term goals. Finally, they describe the recent achievements and near-term thrusts of the research efforts conducted by SERI.

348 **The utility interface - Can state-of-the-art power conditioners alleviate our concerns?.** Stevens, J.W.; Key, T.S. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1168-1174(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

A key issue in adding significant amounts of photovoltaic (PV) generated electricity to the U.S. electric grid is the PV/utility interface. This paper puts into perspective the four most commonly discussed interface issues: harmonic content of the PV system output, power factor at which the system operates, voltage flicker potential attributed to cloud movement over the PV arrays and automatic disconnection of the PV system during a utility outage. For each of these topics, a brief discussion of the concerns will be followed by relevant results of recent research. The role that power conditioning plays in the interface and the direction of ongoing research will be delineated.

349 **Grid-connected PV systems: how and where they fit.** Thomas, M.G.; Jones, G.J. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 991-996(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The use of grid-connected photovoltaic systems requires substantial improvements in system economics. By integrating anticipated improvements in economics with consumer needs and perceptions, we have order-ranked the various potential applications. Thirdparty ownership of large systems appears to have the largest potential, residential has a modest potential, and the intermediate dedicated-load application potential appears to be small.

350 **Federal photovoltaic Utilization Program status report.** Lawson, A.C. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 986-990(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

This paper is a partial status report of the Federal Photovoltaic Utilization Program. Selected photovoltaic systems, already installed or being installed by 24 federal agencies under the sponsorship of the Department of Energy, are described with both text and illustrations. More than 1,000 DOE-funded photovoltaic systems now are in operation providing an estimated peak power output of 410 kW /SUB p/ .

351 **Effects of reflector augmentation on fixed polycrystalline arrays.** Harrison, T.D. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1025-1030(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

The 130-kW photovoltaic system located on the roof of the Omniplex in Oklahoma City, OK was designed with mirrors to increase the amount of solar radiation that strikes the modules during the intervals between spring and autumn equinox and so increases the power generated by the array. The design intent was to produce 130 kW at noon on summer solstice; however at no time has the array produced more than 100 kW. Sandia National Laboratories, Albuquerque, designed a multiphase experiment to determine the reason that the array failed to meet the design intent. This report describes the experiment, the results obtained, and the lessons learned.

352 **Photovoltaic test facility at Florida solar energy center.** Atmanam, G.; Maytrott, C.; Wedekind, D. (Florida Solar Energy Center, Cape Canaveral, FL). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1073-1079(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

A photovoltaic flexible test facility has been developed at the Florida Solar Energy Center. The primary objective was to provide a test bed so that a variety of advanced technology subsystems (arrays and power conditioners) can be characterized and evaluated expeditiously in grid-interactive photovoltaic system operation. Also the systems' and subsystems' safety and reliability can be tested under imposed utility fault and extreme conditions. Such conditions include the utility outage, utility underand over-voltage and possible transient surges. The facility is designed to incorporate two complete parallel photovoltaic systems, one including the roof-mounted array and the other the tracking/adjustable array. The initial performance and test results are presented here along with a description of the facility.

353 **Performance evaluation of large-scale photovoltaic systems.** Fuentes, M.K.; Fernandez, J.P. (Sandia National Laboratories Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1060-1065(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Over the past several years, the U.S. Department of Energy has fielded a number of large-scale photovoltaic (PV) systems as initial experiments for assessing the performance of various PV designs. The array power and power conditioning subsystem (PCS) data have been analyzed from the following six sites: Sky Harbor Airport, Dallas-Fort Worth Airport, Newman Power Station, Lovington Shopping Center, Beverly High School, and the Oklahoma Center for Science and Arts. For all these systems, the peak power was determined to be within 67% of the rated peak. The differences between the actual peak power and rated peak power has been attributed to a number of factors, includmodule failures and array degradation. The peak PCS efficiencies range from 88% to 93%.

354 **Residential photovoltaic retrofits: design, cost and performance.** Russell, M.C. (Massachusetts Institute of Technology, Northeast Residential Experiment Station, Concord, MA). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1007-1012(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

As a part of the National Photovoltaics Program, MIT is designing, building and evaluating improved stand-off mount PV systems for retrofit residential applications. The new PV systems have been designed to achieve lower costs, improved system safety (compliance with the National Electrical Code), lower PV array operating temperatures, higher system efficiency and reduced system complexity. Installed array peak-rated efficiency is expected to be over 11.5%, the array's average temperature rise coefficient is anticipated to be 25 to 30 C/kW/m^2, and the actual incurred BOS costs for materials and labor (excluding purchase of the PV modules and the power conditioner) are expected to be less than $0.70/W.

355 **Performance of silicon solar cells in the concentration range of 150 - 1500 suns.** Sanderson, R.W.; Backus, C.E.; Brikeland, J. (College of Engineering and Applied Sciences, Arizona State University, Tempe, AZ). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1309-1313(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Eight different silicon concentration cells have been tested in sunlight concentrations of one to over 1500 suns. These 1 cm diameter cells were all processed identically by Applied Solar Energy Corporation (ASEC) but had cell thicknesses that varied from 2 to 20 mils. The performance of all the cells were similar at high concentrations except for the expected higher efficiency of the thicker cells due to higher absorption. The efficiencies of the cells were within 10% of the peak efficiency (about 17%) over a range of concentrations from about 10 to 500 suns. Preliminary experiments on current linearity using neutral density filters indicate that the efficiencies at the higher concentrations may be 10 to 20% higher than those reported.

356 **Microprocessor control of photovoltaic systems.** Millner, A.R.; Kaufman, D.L. (TriSolarCorp, Bedford, MA). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1288-1293(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

A new, low power CMOS microprocessor controller has been developed for photovoltaic power systems. Programs have been developed for three types of systems: conventional battery charging systems with state of charge estimation and sequential shedding of subarrays and loads; maximum power controlled battery charging systems; and, variable speed DC motor drives. While this equipment has been utilized for terrestrial applications, it could readily be adapted for spacecraft usage.

357 **Installation, cost, and performance testing of a 30 KW photovoltaic array field based on a low cost modular design.** Noel, G.T.; Alexander, G.; Carmichael, D.C.; Post, H.N. (Battelle-Columbus Laboratories, Columbus, Ohio). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 865-871(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

A modular building block design was developed in a preceding study, which significantly reduces the balance-of-system (BOS) and site specific design costs associated with the installation of ground-mounted flat-panel photovoltaic array fields. The installation of a test-bed array field consisting of three of the building

blocks (nominally 10 kW per building block) is discussed in this paper. The objective of the work reported herein is to demonstrate the cost effectiveness and the technical attributes of the low-cost modular building block design. The actual cost of the firsttime installation was $134.15 (in 1982 dollars) per square meter of array aperture. The cost of a second-time installation of the three-buildingblock array field is estimated to be $78.38 m². Array field performance has been consistent with the design goals.

358 **Operation and maintenance experience at intermediate-sized photovoltaic projects.** Burgess, E.L.; Fernandez, J.P.; Harrison, T.D. (Sandia National Laboratories Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1001-1006(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Operation and maintenance (O&M) costs for two intermediate-sized photovoltaic projects are evaluated for a one-year period after start-up for each project was complete. O&M costs are calculated for both the concentrating system at the DallasFort Worth Airport in Texas and the fixed flat-plate system at the Lovington Square Shopping Center in Lovington, NM. Factors contributing to the O&M costs for each system are discussed.

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REFER ALSO TO CITATION(S) 409

359 **(DOE/SF/10499—T74) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Fourth project design review (RADL Item 1-5).** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Mar 1980. Contract AC03-79SF10499. 294p. (STMPO—141; SAN—0499-29-3-80; MDC-G—8508-3-80). NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE86000661.

A review of the project design of the Barstow Solar Pilot Plant is presented, covering systems, plant control, plant support, receiver, and thermal storage. (BCS)

360 **(DOE/SF/10499—T75S) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Collector subsystem foundations - construction package No. 6 (RADL Item 7-31). Revision 1.** (Stearns-Roger Engineering Corp., Denver, CO (USA)). 18 Dec 1979. Contract AC03-80SF10793;AC03-79SF10499. 61p. (SAN—0499-31-Rev.1; MDC-G—8169-Rev.1; STMPO—143). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000688.

A description of the work performed during the foundation construction for the collector subsystem of the 10 MWe Solar Pilot Plant, near Daggett, California is presented. The construction includes all drilling and excavating, heliostat piers, primary transformer pads, and a variety of foundations required for the weather forecasting equipment.

361 **(DOE/SF/10499—T87S) 10 MWe Solar Thermal Central Receiver Pilot Plat: solar facilities design integration. Construction package No. 13. Painting (RADL Item 7-37).** (Stearns-Roger Corp., Denver, CO (USA)). Jul 1980. Contract AC03-79SF10499. 679p. (STMPO—169; SAN—0499-43; MDC-G—8181). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86000653.

Plans for finish painting of surfaces that were prime painted only, piping identification labeling, caulking of structural joints, cleaning and repair of surface finish painted by others, and finish painting of unprimed pipe, valves and fittings are outlined. (BCS)

362 **(DOE/SF/10499—T119) 10 MWe Solar Pilot Plant, Daggett, California. Heat Tracing System Preoperational Test Procedure 871, Revision 0.** Detweiler, J.R. (Stearns-Roger Corp., Denver, CO (USA)). 1980. Contract AC03-79SF10499. 26p. (STMPO—558). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000709.

Preoperational testing of the heat tracing system of the Barstow Solar Pilot Plant is considered. (BCS)

363 **(DOE/SF/10499—T120) 10 MWe Solar Pilot Plant, Daggett, California nitrogen preoperational test procedure 905. Revision 0.** (Stearns-Roger Corp., Denver, CO (USA)). [1985]. Contract AC03-79SF10499. 26p. (STMPO—589). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000710.

Technical specifications are defined for a gaseous nitrogen supply system capable of supplying nitrogen at the specified pressures at the Barstow Solar Pilot Plant. Procedures for preoperational testing of the supply system are outlined. (BCS)

364 **(DOE/SF/10499—T121) 10 MWe Solar Pilot Plant, Daggett, California. Water Supply Systems Preoperational Test Procedure 910, Revision 0.** Williams, D.L. (Stearns-Roger Corp., Denver, CO (USA)). 1981. Contract AC03-79SF10499. 56p. (STMPO—590). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000711.

Preoperational testing of the water supply systems of the Barstow Solar Pilot Plant is considered. (BCS)

365 **(DOE/SF/10499—T139-Rev.) 10 MWe Solar Pilot Plant, Daggett, California. Receiver steam generation (controls) preoperational test procedure 1030. Revision 0, Sections 1 through 9.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). 23 Dec 1981. Contract AC03-79SF10499. 550p. (STMPO—594-Rev.). NTIS, PC A23/MF A01; 1; GPO Dep. File Number DE86000666.

Preoperational test procedures are outlined for the receiver steam generation controls of the Barstow Solar Pilot Plant.

366 **(DOE/SF/10499—T141) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Plant maintenance/training manual (RADL Item 2-37). Section 1. Rotating apparatus (Book 1 of 3).** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Sep 1982. Contract AC03-79SF10499. 520p. (STMPO—228; SAN—0499-82-Bk.1-Sect.1; MDC-G—9705-Bk.1-Sect.1). McDonnell Douglas Astronautics Co., 5301 Bolsa Ave., Huntington, CA 92647. File Number TI86000698.

The rotating apparatus include the turbine generator and pumps. The equipment is listed and the pumps are described with manuals for specifications and performance. (BCS)

367 **(DOE/SF/10499—T148) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Plant maintenance/training manual (RADL Item 2-37). Section 4. Valves, Book 2 of 3.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Sep 1982. Contract AC03-79SF10499. 675p. (STMPO—235; SAN—0499-82-Bk.2-Sect.4; MDC-G—9705-Bk.2-Sect.4). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86000720.

The valves documented include modulating control and related solenoid valves, air operated stop and related solenoid valves, motor operated valves, safety relief valves, and other solenoid valves. The valves are individually described, including parts lists and specifications. (BCS)

368 **(DOE/SF/10499—T152) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Plant maintenance/training manual (RADL Item 2-37). Section 6. Control and data systems, Book 1 of 3.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Sep 1982. Contract AC03-79SF10499. 344p. (STMPO—239; SAN—0499-82-Bk.1-Sect.6; MDC-G—9705-Bk.1-Sect.6). NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE86000681.

The control and data systems include the control console, the subsystem distributed process control, interlock logic system and signal conditioning unit. The components of the systems are listed and the signal conditioning units are individually described and specified with instructions provided.

360 **(DOE/SF/10499—T155) 10 MWe Solar Thermal Cental Receiver Pilot Plant. Solar facilities design integration. Plant maintenance/training manual (RADL Item 2-37). Section 8 - special heliostat instrumentation and meteorological measurements equipment.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Sep 1982. Contract AC03-79SF10499. 687p. (STMPO—242; SAN—0499-82-Sect.8; MDC-G—9705-Sect.8). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86000656.

Documentation is presented for the special heliostat instrumentation and meteorological measurements equipment of the Barstow Solar Pilot Plant. Instruction manuals are provided for the equipment. The equipment includes data systems, wind towers, pyranometers, air pollution detectors, a tipping bucket raingage, control systems, and temperature sensors. (BCS)

370 **(DOE/SF/10499—T163) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Master control system as-built drawings (RADL Item 6-5). Volume 3. DAS, OCS, and timing.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Sep 1982. Contract AC03-79SF10499. 40p. (STMPO—253; SAN—0499-86-Vol.3-Sect.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001393.

Engineering drawings representing the master control system are presented. The data acquisition system, operating control system and timing system are displayed. (BCS)

371 **(DOE/SF/10499—T164) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Master control system as-built drawings (RADL Item 6-5). Volume 4. SDPC. Section 1. Specification and configuration.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Sep 1982. Contract AC03-79SF10499. 286p. (STMPO—254; SAN—0499-86; MDC-H—030). NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE86001394.

Technical specifications and configurations of the master control system of the Barstow Solar Pilot Plant are presented. (BCS)

372 **(DOE/SF/10499—T166) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Master control system built drawings (RADL Item 6-5). Volume 4: SDPC. Section 3. Drawings.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Sep 1982. Contract AC03-79SF10499. 135p. (STMPO—256; SAN—0499-86-Vol.4-Sect.3; MDC-H—0130-Vol.4-Sect.3). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86001396.

Diagrams of the MVCU, ILS, and multiplexer interface functions for the master control system are presented. The subsystem process control assembly and master control console are illustrated. (BCS)

373 (SERI/CP—251-2680, pp 57-66) **High temperature structural materials research.** Bomar, S.H. Jr. (Georgia Institute of Technology, Atlanta). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

A brief review of high temperature materials research being conducted at Georgia Tech for the Solar Thermal Program is presented. Other tasks are underway but not reported, specifically work on optical pyrometry, advanced concentrator development, and support activities for SERI's Direct Absorption Receiver program.

374 **Electrical design guidelines for photovoltaic/thermal systems.** Lambarski, T.J. (The BDM Corporation Albuquerque, New Mexico). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1045-1050(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

In photovoltaic/thermal (PVT) systems, the performance of cells in a receiver is affected by the thermal design of the system. A significant differential between the inlet and outlet temperatures of the cooling fluid will cause electrical performance to be degraded because of the higher average cell temperatures and because of temperature-induced electrical mismatch among the cells. The study reported in this paper assessed the degree of power loss as a function of the inletoutlet temperature differential and the seriesparallel interconnection pattern. It also quantified the variation of the peak power voltage with insolation, inlet fluid temperature, and fluid temperature differential to assess the impact on the array/inverter interface.

1408 Ocean Energy Systems

375 **(ANL/OTEC-TM—5) OTEC biofouling-control and corrosion-protection study at the Seacoast Test Facility: 1981-1983.** Panchal, C.B.; Larsen-Basse, J.; Berger, L.R.; Berger, J.A.; Little, B.J.; Stevens, H.C.; Darby, J.B.; Genens, L.E.; Hillis, D.L. (Argonne National Lab., IL (USA)). Jul 1985. Contract W-31-109-ENG-38. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86002148.

Results from the first two years of operation of the OTEC Seacoast Test Facility in Hawaii are presented. No detectable biofouling from cold water in smooth tubes has been observed. Intermittent, low-level chlorination appears to control biofouling from warm water in smooth tubes. Uniform corrosion of all aluminum alloys is low in warm water, with no pitting observed. In cold water, preliminary data indicate pitting of all alloys, but corrosion is considerably less uniform than in warm water.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 286, 300, 407, 808, 812, 830, 1174

376 **(DOE/CS/30529—1) SUBIN development work. Final report.** (Solar Concepts Development, Inc., Davis, CA (USA)). Sep 1982. Contract FC02-80CS30529. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000731.

SUNBIN is a passive collector/water storage system which is integrated into the lower portion of a woodframe exterior wall. The system was developed for use in the volume homebuilding market, using a modular component approach designed for rapid installation. The development of two versions of the SUNBIN are presented. Each version is briefly described and illustrated.

377 **(DOE/R0/00036—T1) Chicken-heated solar greenhouse information.** Hart, E.A. (Hart (Elizabeth A.), Fairbanks, AK (USA)). 22 Nov 1983. Contract FG06-79R000036. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000467.

The project consisted of a large, heavily insulated two story building with chickens below and a greenhouse upstairs. The construction and operation of the building are described. The heat and CO_2 produced by the chickens serve the plants in the greenhouse above. Budget information is included. (BCS)

378 **(DOE/R1/10039—T1) Carroll County solar energy project.** (New Horizons for New Hampshire, Inc., Manchester (USA)). 1981. Contract FG41-79R110039. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000385.

The object of this project was to build and demonstrate the use of solar greenhouses in agriculture. Although no technical data is provided, the documentation includes budget information, letters of correspondence, and a technical performance report. (BCS)

379 **(DOE/R1/10060—T1) Solar greenhouse. Final report.** (Community Renewal Team of Greater Hartford, Inc., CT (USA)). 1981. Contract FG41-79R110060. 10p. (CT—79-012). NTIS, PC A02. File Number DE86000390.

A solar greenhouse attached to a school building was constructed and operated. Cinder blocks were used for heat storage be-

neath the plant beds, and thermostatically controlled fan blowers circulate the hot air through the blocks and vent excess hot air. The greenhouse was used for harvesting crops in the Hartford, Connecticut climate. (BCS)

380 **(DOE/R1/10385—T1) Solarization of the Rural Education Center. Final report.** Kaymen, S. (Rural Education Center, Inc., Wilton, NH (USA)). 28 Feb 1982. Contract FG41-80R110385. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000340.

The solar retrofit of a greenhouse and the construction of a solar bath house are briefly discussed. The greenhouse and bath house were constructed to help demonstrate the use of solar energy in the New England area. (BCS)

381 **(DOE/R1/10403—T1) City of North Adams Haskins [School] solar wall. Final project report.** (Housing Now, Inc., North Adams, MA (USA)). 21 Jun 1982. Contract FG41-80R110403. 10p. (MA—80-010). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000358.

The project consists of retrofitting a two section, air cooled, horizontal flow-passive solar collector to a school building. The collector is briefly described and the system performance reveals a savings of 650 to 1000 gallons of oil per year. (BCS)

382 **(DOE/R1/10425—T1) Passive solar renovations to the Common Ground Community Restaurant. Final report.** (Brattleboro Design Group, VT (USA)). [1985]. Contract FG41-80R110425. 8p. (VT—80-007). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000374.

The passive solar and energy conserving renovations to the Common Ground Community Restaurant were funded primarily as a demonstration project under this program. The majority of work accomplished was (1) design and construction of a passive solar greenhouse on the existing second floor porch of the restaurant, and (2) the design and construction of energy conserving improvements to the interior of the building, consisting largely of renovating the walls and ceiling to provide an insulated space with a substantially reduced heat load.

383 **(DOE/R2/05015—T1) Multi-culture solar heated bio-shelter. Final report.** (Petzenbaum (Hannah), Flushing, NY (USA)). [1985]. Contract FG42-79R205015. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000516.

A rooftop greenhouse (bio-shelter) that is heated with active and passive solar systems is presented. The intent of the greenhouse is to grow vegetables hydroponically the year-round using a nutrient flow technique; and to growth the giant tropical Malaysian prawn Macrobrachium rosenbergii in a recycling raceway water system heated with solar power. The produce grown was continuously monitored and the harvests weighed in order to estimate the year-round production potential of the bio-shelter greenhouse.

384 **(DOE/R2/05016—T1) Solar water heating and drier heat recovery system for a laundromat. Final report.** (Sol Control Co., Inc., Troy, NY (USA)). 1979. Contract FG42-79R205016. 14p. NTIS, PC A02. File Number DE86000506.

The integration of a solar water heating system and drier heat recovery system into a public laundromat is demonstrated. The heat recovery system proposal was discarded, but 9 flat plate solar collectors were installed on the roof of the laundromat for heating water. The water heating system performed well enough to meet all maximum capacity needs for 6 washing machines. Cost information is included. (BCS)

385 **(DOE/R2/05031—T1) Energy conserving passive solar home project. Final technical report.** (State Univ. of New York, New Paltz (USA)). 1982. Contract FG42-79R205031. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000503.

The design and construction of an energy conserving passive solar home is presented. A greehouse and an earth berm are integrated into the design of the house. (BCS)

386 **(DOE/R2/05033—T1) Solar hot water heating system for education, with real savings for the institution. Final report.** Menz, P. (Cumberland County Coll., Vineland, NJ (USA)). 1 Oct 1980. Contract FG42-79R205033. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000499.

The project consisted of installing a complete solar system for the pre-heating of hot water for showers and kitchen facilities at Cumberland County College in Vineland, New Jersey. The system included about 150 square feet of collector and measuring instruments to record the functional parameters and monitor the performance. An estimate of yearly energy savings and a budget are provided. (BCS)

387 **(DOE/R2/05182—T1) Development of status indicating solar system controller. Final report.** Ross, W. (Ross (William), Brooklyn, NY (USA)). 1982. Contract FG42-80R205182. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000483.

The development of a status reporting controller that would enable the owner or operator of the solar system to monitor its functioning manually is presented. The controller also provides an automatic fault detection device with alarm to indicate when, and in which sub-system, failure occurs.

388 **(DOE/R9/50012—T1) Spectrally selective flow-through greenhouse panels. Final report.** Huffman, D.R. (Huffman (Donald R.), Tucson, AZ (USA)). 23 Dec 1983. Contract FG03-80R950012. 26p. (AF—80-25). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000444.

This report describes the development of a special type of flow-through glazing and its application to small greenhouse construction in the desert climate of southern Arizona. The concept is described and the various aspects of development and design are described including some discussion of errors and wrong directions taken, given with some personal embarrassment in hopes of saving others from similar failures.

389 **(DOE/SF/11614—T1) Hybrid cooling system for refrigeration. Final report.** Schlussler, L. (Schlussler (Larry), Arcata, CA (USA)). [1985]. Contract FG03-81SF11614. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000470.

The development of an energy efficient hybrid cooling system for refrigeration (temperatures above 32°F) is presented. During cold weather the system operates in a passive mode and in warm weather the system actively cools. When in the active mode, ice is produced at night and stored for daytime cooling. The same heat exchangers are used for both the passive and active systems. (BCS)

390 **(DOE/SF/11627—T1) Project SUNN solar home (APTECH AZ-81-54). Final report.** Birkey, R.C. (SUNN, Inc., Window Rock, AZ (USA)). 1983. Contract FG03-81SF11677. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000402.

The design and construction of the SUNN solar home utilizing energy conservation relevant to the constuction needs of the Navajo Nation has met with success, most particularly in its initial student and Navajo leadership training programs. The overall size of the structural concept was increased dramatically (from the modest 700 to 900 square foot model to an 1856 sq. ft. structure) in order to accommodate the Window Rock School District with a practical building and the placement of SUNN home in a highly visible area of the school grounds. A cooperation was formed with the school district with intentions to increase the potential for publicity, community involvement, utilize students in the construction process, and develop professional interest in the utilization and transfer of SUNN home technologies for other Navajo communities.

391 **(EUR—8947-EN) Solar heating: Performance of recent systems.** Godoy, R.; Ferraro, R. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 358p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

This document describes 17 monitored active and passive solar heating projects. The projects have been selected because they illustrate areas of particular interest to designers or because they represent in some way an addition to or a development from earlier systems reported by the CEC Performance Monitoring Group. The report includes a section on individual projects, where design, cost and performance data is discussed, and a general overview of all the projects, were trends are analysed and a comparative study carried out.

392 **(MRI/SOL—0201) SOLERAS - Solar Cooling Engineering Field Tests Project: Carrier Corporation. Fabrication, testing and installation report: 53 kW solar absorption cooling system.** (Midwest Research Inst., Kansas City, MO (USA)). [1985]. Contract FC02-80ET20643. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001274.

A 53 kW water cooled packaged solar absorption chiller was fabricated and tested. The generator shell and absorber shell had sight glasses added as a diagnostic device. The unit was modified so that a base suitable for mounting pumps, valves and associated piping was cantilevered from one end of the unit. The installation and start-up of the cooling system is outlined.

393 **(MRI/SOL—0800-07) SOLERAS - Solar Controlled Environment Agriculture Project. Final report, Volume 7. Science Applications, Incorporated field test facility preliminary design.** (Midwest Research Inst., Kansas City, MO (USA)). [1985]. Contract AC02-83CH10093. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001290.

This report contains the preliminary design of an SCEAS Engineering Test Facility (ETF). The ETF is a 3600 m^2 fluid roof greenhouse with an inflated plastic film roof to maintain a clean environment for the fluid roof and to protect the inner glazing from hail and other small missiles. The objective of the design was the faithful scaling of the commercial facility to ensure that the ETF results could be extrapolated to a commercial facility of any size. Therefore, all major features, including the photovoltaic power system, an integral water desalination system and even the basic structural module have been retained. The design is described in substantial detail in the body of this report, with appendices giving the drawings and specifications.

394 **(PB—85-212223/XAB) Use of solar energy for heating an asphalt storage tank. Final report.** Hilton, M.H. (Virginia Highway and Transportation Research Council, Charlottesville (USA)). Aug 1984. 62p. (VHTRC—85-R5). NTIS, PC A04/MF A01.

A 10,000 gal. asphalt storage tank was equipped with a solar heating system and instrumented to determine its effectiveness over a 12.5-month period. An evaluation of the data was used to determine if an investment in solar-energy systems to assist in heating asphalt is a favorable alternative to the conventional electrical heating system used by the Virginia Department of Highways and Transportation.

395 (SERI/CP—251-2680, pp 119-138) **Effects of radiant heating on decomposition of zinc sulfate.** Tabatabaie-Raissi, A.; Antal, M.J. Jr. (Univ. of Hawaii, Honolulu). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

One of the most promising applications of concentrated solar energy is direct solid phase decomposition of materials for the production of fuel and chemicals. A fundamental understanding of high temperature, high heating rate solid phase decomposition chemistry is essential in developing technologies needed to solve the future fuel crisis. Since solar furnaces are expensive to build and operate, new conversion techniques are needed which enjoy process economy, high efficiency and product selectivity. Recent results of research concerned with fundamental studies of the high temperature solid phase decomposition of zinc sulfate at low and high heating rates are presented. The low heating rate studies were carried out using a conventional thermogravimetric system (Setaram Simultaneous TGA/DTA unit). The high heating rate results were obtained in a novel, Fast-TGA system capable of rapidly weighing materials exposed to concentrated radiant energy derived from an arc image furnace.

396 (SERI/CP—251-2680, pp 139-147) **Direct radiant heating of particle suspensions.** Hunt, A.; Ayer, J.; Hull, P. (Lawrence Berkeley Lab., CA). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—). Contract AC03-76SF00098.

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

Recent advances in the research program at Lawrence Berkeley Laboratory (LBL) in understanding the behavior of the use of gas-particle suspensions to absorb concentrated sunlight to supply energy for endothermic chemical reactions was studied. The goal was to understand the optical, thermodynamic, and chemical processes in solar heated particle suspensions through a balanced program of analytical and experimental investigations. This work is aimed at establishing a technology base supporting new applications of concentrated sunlight for the production of useful fuels and chemicals.

397 (SERI/CP—251-2680, pp 167-176) **Laboratory evaluation of the solar incinerability of hazardous organic wastes.** Graham, J.L.; Dellinger, B. (Univ. of Dayton, OH). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

A review of the literature on photochemistry shows that there is almost no information available on high-temperature gas-phase photochemistry applicable to the possible solar incineration of hazardous organic wastes. An overview of a laboratory study which the Environmental Sciences Laboratory at the University of Dayton Research Institute will be conducting to investigate the combined thermal and photolytic decompositon characteristics of this class of compounds is presented.

398 (SERI/CP—251-2680, pp 177-186) **Nonequilibrium processes.** Johnson, D.H.; Wang, K.Y. (Solar Energy Research Institute, Golden, CO). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

Work on assessing the possibility of using nonequilibrium heating and cooling to enhance the final concentration of desirable chemical produced by a reacting gaseous mixture is discussed. What is meant by nonequilibrium heating and cooling is described and a method by which the process may be achieved using the unique properties of solar radiation is outlined. Past work by others on the nonequilibrium chemical kinetics of a reacting mixture initially composed of nitrogen and oxygen (air) is reviewed. The chemical of value produced by this reaction is nitric oxide, a precursor to nitric acid and ammonia. Finally, the goals and FY85 objectives and approach to achieving these objectives are reviewed.

399 **Passive solar options for commercial buildings.** Rushkin, S. (California Energy Commission, Sacramento, California). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* **6**: 735-740(Jun 1983).

In contrast to residential buildings, commercial buildings are often internally load dominated, have much different hours of use and serve a much more diverse range of functions. The energy implications of these differences are that commercial buildings require a new set of passive solar design strategies from those developed for the residential sector. This paper presents an initial palette of solar measures and design considerations which address the specialized energy needs of commercial buildings. These measures have been established as effective technologies in many case studies.

400 **A statistical analysis of passive solar superinsulated homes in Minnesota.** Fugerson, M.; Lancaster, R. *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 723-728(Jun 1983).

This study analyzed the space heat performance of 46 passive solar superinsulated homes whose construction was financed by the Minnesota Housing Finance Agency (MHFA). heat gain and loss calculations were used to predict the auxiliary heating energy required by the houses. These calculations were adjusted for actual weather conditions, thermostat settings and other variables during the 1981-1982 heating season. The sample was divided into two sub-samples, one containing houses with ratios of south glass area relative to floor area of 8.5% or larger, and a second with smaller ratios of south glass area to floor area. The results suggest that houses with larger south glass area relative to floor area may not perform as predicted. These houses appeared to have more heat loss than heat gain associated with the south windows. In the houses with less south facing glass, the passive solar components appeared to perform as predicted.

401 **Empirical validation using data from the seri class-A validation house.** Judkoff, R.; Burch, J.; Wortman, D. (Solar Energy Research Institute, Golden, CO). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 705-710(Jun 1983).

A residential test building at the SERI Interim Field Site was monitored at the Class-A level during the spring of 1982. The building was also modeled on three building energy analysis simulations--DOE2.1A, BLAST 3.0, and SERIRES--using measured weather data from the test period and the location. The measured energy performance data, and that predicted by the simulations, were compared. More correct input files for the codes were developed using measured values of input parameters, and the results were also compared with the measured performance data. The comparisons show that input errors can contribute to predicted auxiliary energy requirements which are on the order of 60% or more higher than the measured loads, and that improvements in input variables could reduce these errors significantly.

402 **A correction factor to f-Chart predictions of active solar fraction in active-passive heating systems.** Evans, B.L.; Duffie, J.A.; Klein, S.A. (Solar Energy Laboratory, University of Wisconsin-Madison, Madison, WI). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 677-682(Jun 1983).

The object of this study was to determine to what extent a passive system degrades the performance of an active solar space heating system, and to develop a correction factor to account for these interactions, if warranted. The transient system simulation program TRNSYS has been used to simulate the hour-by-hour performance of combined active-passive (hybrid) space heating systems in order to compare the active system performance with simplified design method predictions. After establishing a number of probable factors in active-passive interactions, TRNSYS simulations were compared to results obtained using the simplified design calculations of the fChart method (2). First, comparisons of TRNSYS and f-Chart were used to establish the accuracy of the f-Charts for active systems. A correlation was then developed to correct the monthly loads input into the f-Chart method to account for controller deadbands in both hybrid and active only buildings. Additional comparisons were then used to develop a general correction factor to be applied to the f-Chart method to produce more accurate and useful results for hybrid systems.

403 **Sol-air heating and cooling degree-days.** Erbs, D.G.; Beckman, W.A.; Klein, S.A. (Solar Energy Laboratory, University of Wisconsin-Madison, Madison, WI). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 894-900(Jun 1983).

A set of relationships are developed which allow the estimation of sol-air heating and cooling degree-days at any base temperature. The method makes use of existing relationships for hourly utilizability and degree-days, and the only input required is the monthly average solar radiation and ambient temperature. Solar radiation which is absorbed on outside surfaces and solar radiation which is transmitted through glazings are accounted for in the analysis. Estimated sol-air degree-days are compared with sol-air degree-days determined using long-term hourly data, and good agreement is observed. Sample calculations for a simple structure illustrate the use of solair degree-days.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 305, 376, 389, 392, 812

404 **(DOE/R0/01318—T1) Theory of the geyser-pump solar collector. Final report.** Haines, E. (Bohemia Solar and Scientific, Inc., Eugene, OR (USA)). [1985]. Contract FG06-81R001318. 53p. (OR—81-004). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000487.

The geyser-pump solar collector is a self-controlling, self-pumping active collector having no moving or electronic parts, drawing its mechanical pump energy from boiling in the collector's risers. The only use of the geyser-pump principle reported in patents and the open literature is only for circulating the fluid in the collector plate. Computer simulations show that most design and algorithm parameters have only negligible impact on solar fraction, F. The only parameter which affects F is the length of the storage heat exchanger. Episodic cloud cover does not hamper the geyser-pump collector's ability to restart. Daylong simulations show that the energy cost of geyser-pumping is only about 3% of the absorbed insolation. The geyser-pump collector is found to be as efficient as an electrically pumped collector. Initial costs are estimated to be about the same for the geyser-pump and conventional collectors, but lifetime costs of the geyser-pump are substantially lower, perhaps only half, because of low maintenance.

405 **(DOE/R1/22239—T1) Conversion of coastal waters into solar ponds. Final report.** Multer, R.K. (AIDCO Maine Corp., Orr's Island (USA)). 30 Jun 1983. Contract FG41-81R122239. 36p. (ME—81-005). NTIS, PC A03. File Number DE86000379.

This project was stimulated by recognition that the cost of these economically justifiable systems could be cut to half or less by building along the seacoast using solar-evaporated seawater instead of the usual purchased salt, where the usual impermeable polymer membranes might be omitted, and where excavation could be minimized by converting natural inlets of the sea. The operating principles of solar ponds are explained, and costs and energy yields predicted so readers can evaluate the concept. The proposed method of converting natural coastal waters into exceptionally inexpensive solar ponds is described. Potential solar pond sites are described ranging from 400-acre Back Cove in Portland that might heat 5000 to 10,000 homes, through somewhat smaller prospects at Great Pond in Cape Elizabeth, Sears Island, and Portland Jetport, to systems of just a few acres for a great many mainland and island sites. Special attention is directed to a 3-acre tidewater lagoon at York Harbor that is physically almost ready for filling as a solar pond, and a 3-acre inlet at the Burnham and Morrill factory in Portland that could pay for itself by delivering process heat while serving as a pilot plant for the giant Back Cove project.

406 **(DOE/R1/23279—T1) Third generation flat plate solar collector. Final report.** (TDEnergy, Inc., Boston, MA (USA)). 1983. Contract FG41-81R123279. 25p. (MA—81-015). NTIS MF A01; 2; GPO Dep. File Number DE86000377.

The design of a flat plate solar collector that meets an allowable cost constraint is studied. The cost constraint is $5 to 6 per square foot. A medium-temperature collector prototype with a non-thin film absorber was constructed and tested. (BCS)

407 **(DOE/R2/05164—T1) [Hemicylindrical collector.] Final report.** Hayford, W.H. (Hayford (William H.), Hewitt, NJ (USA)). 30 Oct 1981. Contract FG42-80R205164. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000405.

A new type of collector that is "self-orienting" and has improved heat transfer capability is developed. The solar collector incorporates a hemicylindrical collector surface and protruding

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hollow, tubular fins and a storage reservoir. Field testing showed that with proper orientation and a clear sunny day, the reservoir temperature can exceed 120°F. (BCS)

408 (SERI/CP—251-2680, pp 1-7) **Silver/polymer films for concentrators.** Benson, B.A. (3M Co., St. Paul, MN). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

A highly specular aluminized acrylic film 3M Brand ECP-244 has been in use on parabolic trough solar collectors for up to 8 years. Currently, over 600,000 ft^2 are in use on 30 installations throughout the US. Two years ago, a program was initiated to develop a silver version of ECP-244 to increase the spectral reflectance from 86% to 95%. The first generation silver film, ECP-300X, was produced in September 1983 and has been installed on numerous test installations. Although field tests have been positive after up to 14 months, accelerated aging has shown the need for greater UC resistance. Therefore, the effort was continued to develop a second generation product, ECP-300, with greatly improved accelerated aging resistance. The development of ECP-300 is discussed.

409 (SERI/CP—251-2680, pp 27-38) **Stretched membrane heliostat research.** Murphy, L.M. (Solar Energy Research Institute, Golden, CO). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

Large, structurally efficient and optically accurate solar reflectors and concentrators for solar thermal applications are feasible using the stretched-membrane concept. In this concept a high-strength structural membrane, coated with a highly reflective surface, is stretched uniformly on a frame (typically a lightweight hollow toroidal structure). The stretched-membrane concept is a method of attaining and supporting a large, optically accurate surface, which results in lighter weight and lower cost structures than are currently available. This concept also is especially suitable for the use of polymer reflectors and structural membranes, which may result in further weight and cost reductions and improvements in handling at the factory, in the field, and in transport. The feasibility of the concept is discussed.

410 (SERI/CP—251-2680, pp 39-48) **Heliostat wind load reduction.** Peterka, J.A.; Cermak, J.E. (Colorado State Univ., Fort Collins). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

Research on heliostat fabrication indicates that future heliostats may be significantly lighter than current ones. In this event, the ratio of wind-induced to weight-induced loading of the drive mechanism will be increased. A method for reduction of wind loads on heliostats within typical field layouts is desirable in order that drive loads may be kept as low as possible. Methods for reducing wind loads on heliostats in typical field layouts are discussed. The research methodology is to measure wind loads on model heliostats in a boundary layer wind tunnel.

411 (SERI/CP—251-2680, pp 49-56) **Holographic concentrators.** Hull, J.L. (Acurex Corp., Mountain View, CA). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

An innovative concept applied to the development of low-cost solar concentrators for both parabolic trough and paraboloid dish applications is presented. The approach selected is the fabrication of holographic optical elements which will focus sunlight to either a line or a point.

412 (SERI/CP—251-2680, pp 67-77) **Photoeffects in high temperature materials.** Ignatiev, A. (Univ. of Houston, TX). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—).

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

Solar materials exposed to high temperatures (300-800°C) and high solar fluxes (0.5 to 1.5 MW/m^2) are expected to degrade under mechanisms which have not been previously characterized in high temperature studies of material stability. Not only is the adsorption for the visible radiation spectrum of solar radiation expected to be more surface localized (smaller absorption length) than that of infrared radiation (due to oven or furnace heating), but also the presence of visible/near ultraviolet photons in the solar spectrum may cause specific quantum effects affecting stability. The smaller absorption length for solar radiation may result in surface localized heating of materials with resultant induced thermal stress, enhanced surface corrosion, etc. The quantum effects may, however, be more varied and have to date been shown to be of detrimental and of beneficial nature to the stability of high flux, high temperature solar materials.

413 (SERI/CP—251-2680, pp 79-87) **Solid particle receivers: a status report.** Hruby, J.M. (Sandia National Labs., Livermore, CA). Apr 1985. NTIS, PC A10/MF A01. File Number DE85002938. (CONF-850252—). Contract AC04-76DP00789.

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

The status of the solid particle receiver program is reviewed. Significant progress has been made in identifying and characterizing candidate particle materials, analyzing the thermal performance of a solid particle receiver, and performing engineering experiments to verify concepts and analytical calculations. Based on the work performed to date, the solid particle receiver concept appears to be technically feasible and promising as a high temperature receiver concept.

414 (SERI/TR—255-2410) **Silver-silicon bonding on silica surfaces.** Pitts, J.R. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1985. Contract AC02-83CH10093. 253p. NTIS, PC A12/MF A01; GPO Dep. File Number DE85012138.

The properties of Ag films deposited on silica or silica-based glass substrates have been investigated using X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), ion scattering spectrometry (ISS), and secondary ion mass spectrometry (SIMS). Interfacial studies are reported for films prepared by decomposing organometallic Ag on glass, depositing Ag by the wet chemical electroless method onto glass and SiO_2, and vacuum evaporating Ag onto SiO_2. For organometallic Ag films on glass, depth profiles indicate that the interfacial regions are enriched in Si or depleted in O. For electroless films, Sn-Si bonds are formed after sensitization with tin chloride and Ag-Si bonds are formed after silvering without reducers. Silver is strongly bonded to Si via a set of Sn insertion reactions, but impurities were found at the interfaces and these probably contribute to the rapid degradation of mirrors in terrestrial environments. Particle bombardment of silica with He, Ne, Ar or electrons in the range of 0.25 to 8 keV results in reduction of the surface to form SiO/sub x/ (x 2). Although complete reduction was not observed, enrichment of the surface in Si prior to vacuum deposition of Ag improves the adhesion of the film. Angle resolved XPS and ISS on one monolayer of evaporated Ag and SiO_2 indicate that Si is preferentially masked by the Ag, suggesting that Ag is in an atop position over the Si atoms in silica.

415 **A comparison of concentrating collectors to tracking flat panels.** Jones, G.J. (Sandia National Laboratories, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference;* 1190-1195(May 1984). (CONF-840561—).

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Two-axis tracking appears to be the economic optimum for photovoltaic flat-panel technology. This requires a new comparison of flatpanel and concentrator arrays using the most competitive flat-panel option. The array field costs for a two-axis tracking flat-panel should be nearly identical to the costs for a concentrator. Therefore, module costs for the two technologies can be compared directly, simplifying the analysis. For example, at southwestern

sites, characterized by a high direct-to-diffuse insolation ratio, 12% flat-panels are found to be equivalent to 15% concentrators of the same cost ($/M^2). For regions with more diffuse radiation the concentrator must be over 18% efficient to be equivalent.

416 **Optimization of integrated CPC evacuated collector tubes and arrays.** Winston, R.; O'Gallagher, J.; Snail, K. (University of Chicago, Enrico Fermi Institute, Chicago, IL). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* **6**: 361-366(Jun 1983).

The Integrated Stationary Evacuated Concentrator or ISEC solar collector has achieved the best high temperature performance ever measured with a stationary collector. A development program to carry out a design review of the initial proof of concept configuration has been completed. Changes in the optical design to improve the angular response function and increase the optical efficiency have been determined. Parasitic thermal and pumping losses have been shown to be reducible to acceptable levels, and a passive approach to the problem of ensuring stagnation survival has been identified.

1420 Heat Storage

417 **(DOE/ET/20111—T1) Membrane-lined storage for solar heating systems. Installation manual.** (Davis Energy Group, CA (USA)). Dec 1982. Contract AC02-78ET20111. 172p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86000844.

This installation manual describes techniques for construction of low cost, membrane-lined thermal storage tanks for solar heating applications. Designs and installation procedures are described for a series of tanks ranging in size from 570 to 1330 gallons. The units are designed for installation in a basement corner, using conventional wood frame construction techniques. Hydronics and control components are described in addition to tank details.

418 **(DOE/ET/20111—T2) Workshop manual. Solar energy storage workshop featuring site built tanks with membrane liners.** (Nebraska Univ., Lincoln (USA). Solar Resource Development Office). 1982. Contract AC02-78ET20111. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86000843.

A manual is presented on the topic of solar energy storage. General information is provided on sensible heat storage including aspects such as heat capacity, heat loss and heat exchangers. Thermal energy storage in liquid-based systems is also discussed with special emphasis on storage tanks. (BCS)

419 **(DOE/R1/10065—T1) Thermal energy storage by means of saturated aqueous solutions in glass tubes. Final report, July 1979-January 1981.** Clark, P.D. (Sunsearch, Inc., Guilford, CT (USA)). 1981. Contract FG41-79R110065. 69p. (CT—79-009). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000370.

The findings are presented of an investigation into using a plurality of glass tubes filled with heat storage material to act as a heat exchanger and thermal storage means for solar systems and other applications requiring low temperature thermal storage. Criteria for storage materials and related candidates are presented. Results of tests with individual tubes and with working prototypes are presented. Preliminary product design and estimated costs are included.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

420 **(DOE/ID/12471—T1) Geothermal energy resource investigations in the Eastern Copper River Basin, Alaska.** Wescott, E.M.; Turner, D.L. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). Jun 1985. Contract FG07-84ID12471. 225p. (UAG-R—302). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86001803.

This report consists of a review of the geological, geochemical and geophysical data available for the Eastern Copper River basin with emphasis on the mud volcanoes, and the results of geophysical and geochemical studies carried out in the summers of 1982 and 1984. The purpose was to determine if there are geothermal energy resources in the Copper River Basin. The Eastern Copper River basin is situated on the flanks of a major volcano, Mt. Drum, which was active as late as 200,000 years ago and which is thought to have retained significant amounts of residual heat at high levels. Mt. Wrangell, farther to the east, has been volcanically active up to the present time. The 1982 geophysical and geochemical surveys located three principal areas of possible geothermal interest, one near Tazlina and two near the Klawasi mud volcanoes. The intensive survey work of 1984 was concentrated on those areas. We have integrated the results of soil helium, soil mercury, gravity, aeromagnetic, electrical, self-potential, and controlled-source audio magnetotelluric (CSAMT) surveys to evaluate the geothermal potential of the areas studied. 36 figs.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 420

421 **Water influx modeling of Svartsengi geothermal field, Iceland.** Gudmundsson, J.S.; Olsen, G. (Stanford Univ.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13615**: 265-274(Mar 1985). (CONF-830512—).

From IEE/APS symposium; Houston, TX, USA (23 May 1983).

Lumped-parameter models are presented for confined and unconfined liquid-dominated geothermal reservoirs without recharge, and compared to production data from the Svartsengi field in Iceland. They show that recharge or water influx is likely to affect the field's draw-down with time. Three petroleum reservoir water influx methods are then presented for steady state, pseudo-steady state and unsteady state aquifers encroaching into the geothermal reservoir. Matching the production history shows that the reservoir-aquifer system is best described as linear, and with the aquifer's boundary taken at infinite distance.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 431, 1485

422 **(DOE/ID/12079—128) Preferred methods of analysis for chemical tracers in moderate- and high-temperature geothermal environments.** Kroneman, R.L.; Yorgason, K.R.; Moore, J.N. (SEE CODE- 9520101 Utah Univ., Salt Lake City (USA). Earth Sciences Lab.). Dec 1984. Contract AC07-79ID12079. 47p. (ESL—84001-TR). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002008.

This report describes the sampling and analytical techniques used for tracer analysis in the Raft River and East Mesa field tests. The collection procedures and sample preservation techniques, analytical methods and possible sources of contamination or error are discussed in detail. 6 refs.

423 **(DOE/ID/12307—1) Heat flow and geothermal studies in the state of Washington.** Blackwell, D.D.; Steele, J.L.; Kelley, S.A. (Southern Methodist Univ., Dallas, TX (USA). Dept. of Geological Sciences). Aug 1985. Contract AI07-81ID12307. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001550.

Existing geothermal gradient and heat flow data for the state of Washington are summarized. In addition, information on mean-annual ground surface temperatures is included. The data consist of accurate, detailed temperature-depth measurements in selected available holes throughout the state of Washington made between 1979 and 1982. Measurements of thermal conductivity on selected rock samples from these drill holes and ancillary information required to assess the significance of the data and calculate heat flow values were obtained as well. Information is presented on the mean-annual ground-surface temperatures throughout the state of Washington. 32 refs., 15 figs., 4 tabs.

424 **(DOE/SAN/12196—14) Very low frequency magnetotelluric and dipole-dipole responses of three-dimensional thin-layer resistivity structure modeled using finite elements.** Wannamaker, P.E. (SEE CODE- 9520101 Utah Univ., Salt Lake City (USA). Earth Sciences Lab.). Sep 1985. Contract AC03-84SF12196. 36p. (ESL—159). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002011.

An algorithm to simulate the very low frequency magnetotelluric and dipole-dipole responses of three-dimensional thin-layer inhomogeneity has been developed from an existing finite element program used to simulate resistivity/IP signatures of 2-D earth sections. The 3-D body is confined to and extends uniformly across a thin layer overlain by air and underlain by infinite resistivity. Electric fields are obtained through differentiation of piecewise parabolas fit to nodal voltages while magnetic fields arise from integration of the free-space Green's tensor over secondary current perturbations throughout the thin layer. Dipole-dipole apparent resistivities arise through application to nodal voltages of the logarithmic geometric factors appropriate to continuously grounded line sources of current. Checks on accuracy of the simulation utilize analytic solutions, 2-D AC plane-wave results using finite elements, and a surface integral equations technique. 18 refs., 14 figs.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 112, 425, 426

1508 Geothermal Power Plants

425 **Numerical evaluation of contact and hybrid condensers for geothermal power plants.** Weres, O. (Earth Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Geothermics;* **13**: No. 4, 305-318(1984).

-The transport and partitioning of gases in two contact condensers in use at The Geysers has been modelled numerically. Improvements on these designs have been investigated. Adding a surface type vent condenser between the main condenser and the first stage gas ejectors improves hydrogen sulphide partitioning dramatically. This "hybrid condenser" can match the performance of a surface condenser. Adding a contact type gas cooler allows 90% partitioning to be attained with steam that contains little ammonia.

426 **Numerical evaluation of surface condensers for geothermal power plants.** Weres, O. (Earth Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Geothermics;* **13**: No. 4, 293-304(1984).

The transport and partitioning of gases in four surface condensers for geothermal power plants has been modelled numerically. A vent condenser between the main condenser and the first stage gas ejectors improves hydrogen sulphide partitioning, particularly if the condensate from it, and from the inter- and aftercondensers, is recirculated to the main condenser tube bundles. Regardless of steam composition, hydrogen sulphide emissions may be largely eliminated by a Stretford Unit combined with a suitable surface condenser. However, if the steam contains ammonia it may be necessary to add sulphur dioxide to neutralize part of the ammonia. In no case is hydrogen peroxide needed to largely eliminate hydrogen sulphide air pollution.

1509 Geothermal Engineering

427 **(BNL—36933) Advanced materials for geothermal energy processes.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Aug 1985. Contract AC02-76CH00016. 15p. (CONF-8509142—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001183.

From Geothermal program review; Washington, DC, USA (11 Sep 1985).

The primary goal of the geothermal materials program is to ensure that the private sector development of geothermal energy resources is not constrained by the availability of technologically and economically viable materials of construction. This requires the performance of long-term high risk GHTD-sponsored materials R and D. Ongoing programs described include high temperature elastomers for dynamic sealing applications, advanced materials for lost circulation control, waste utilization and disposal, corrosion resistant elastomeric liners for well casing, and non-metallic heat exchangers. 9 refs.

428 **(DOE/SF/15548—T2) Two phase flow in geothermal systems. Bi-monthly progress report, July 16-September 15, 1985.** DiPippo, R.; Laoulache, R.N. (Brown Univ., Providence, RI (USA)). Sep 1985. Contract AC03-85SF15548. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000865.

Preliminary findings of one of the early test runs of two newly constructed quick-closing valves (QCVs) are presented. The purpose was to see whether the QCVs could be activated simultaneously and closed rapidly without causing excessive over-pressure in the test section.

429 **(LA-UR—85-3333) Open hole packer and running procedure for hot dry rock reservoir testing.** Dreesen, D.S.; Miller, J.R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 8p. (CONF-8509142—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000817.

From Geothermal program review; Washington, DC, USA (11 Sep 1985).

An acute need for open hole packers for high pressure, high temperature operations at the Fenton Hill, Hot Dry Rock (HDR) Geothermal Site has existed since 1981. Cemented-in-liners were used instead of packers while packer technology was brought up to HDR requirements. A reservoir development and evaluation program has just been completed with 5 successful open hole packer runs. These 5 successful runs were the result of: (1) R and D leading to improved packer materials and design, (2) an improved understanding of the interactions between the packer assembly and its hostile down hole environment, and (3) a carefully planned logging, sampling and coring program to locate packer setting depths (packer seats). 5 refs.

430 **(LA-UR—85-3334) Hot dry rock Phase II reservoir engineering.** Murphy, H.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-8509142—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000815.

From Geothermal program review; Washington, DC, USA (11 Sep 1985).

Early attempts to hydraulically fracture and connect two wells drilled at the Hot Dry Rock site at Fenton Hill in New Mexico failed. Microearthquakes triggered by hydraulic fracturing indicated that the fracture zones grew in unexpected directions. Consequently one of the wells was sidetracked at a depth of 2.9 km; was redrilled into the zones of most intense microseismic activity; and a flow connection was achieved. Hydraulic communication was improved by supplemental fracturing using recently developed high temperature and high pressure open hole packers. Preliminary testing indicates a reservoir with stimulated joint volume which already surpasses that attained in the earlier phase I reservoir after several years of development. 12 refs., 6 figs.

431 **(SAND—85-1138) Geothermal Technology Development Program. Annual progress report, October 1983-September 1984.** Kelsey, J.R. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1985. Contract AC04-76DP00789. 265p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86001153.

This report describes the status of ongoing Research and Development (R and D) within the Geothermal Technology Development Program. The work reported is sponsored by the Department of Energy/Geothermal Hydropower Technology Division (DOE/GHTD), with program management provided by Sandia National Laboratories. The program emphasizes research in rock penetration mechanics, fluid technology, borehole mechanics, diagnostics technology, and permeability enhancement. 102 figs., 16 tabs.

432 **Today's achievements, and a look at future developments.** Carson, C.C. (Sandia National Lab., Albuquerque, NM). *World Oil;* **199**: No. 1, 151-153;156-157;160(Jul 1984).

Sandia National Laboratories conducts research for DOE's Geothermal Technology Development Program, which is a program aimed at developing new drilling and completion tools and techniques for application in geothermal wells (although results can be considered applicable to the general drilling industry). To aid in identification and selection of research projects, a oneyear investigation of current and future of drilling technology was recently conducted. This article summarizes results of the study that address the nature of future drilling systems.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 393

433 **(DOE/SF/11624—T1) Drilling, completion, and testing of geothermal wells CD-1 and CD-2, Caliente, Nevada.** Larson, K.; Flynn, T. (Caliente, City of, NV (USA); REMCO, Reno, NV (USA). Earth Sciences Div.). 1982. Contract FG03-81SF11624. 76p. (NV—81-001). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86000401.

Two geothermal test wells were drilled in January 1983, in Antelope Canyon to access the potential for resource utilization by the City of Caliente's proposed space heating district. Both holes, drilled into bedrock at 220 feet, encountered hot water in the upper part of the hole (40 to 100 feet) and cooler water below (100 to 210 feet). A series of pumping tests were completed in February 1983, including pump-efficiency tests, stepped draw-down tests, and 1-, 2-, and 3-day sustained pumping tests. The test results indicated that the transmissivity of the thermal aquifer is very, very high. Five water samples were collected for chemical analyses during the course of CD-1 pump tests. The samples were collected to determine the water quality for the proposed space heating district and possible reinjection, and to establish a water chemistry base-line for comparative analysis of fluid chemistry during the course of the pumping and from subsequent development. 7 refs., 18 figs., 3 tabs.

16 TIDAL AND WAVE POWER

1604 Economics

434 **(DOE/R1/22238—T1) Report on the preliminary feasibility study of tidal power development.** (Kleinschmidt and Dutting, Pittsfield, ME (USA)). Jul 1982. Contract FG41-81R122238. 32p. (ME—81-004). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000380.

It was determined that a tidal power plant at the basin on Vinalhaven Island, Maine would not be economical. This conclusion is based on the probable costs for various numbers and sizes of turbines, as well as other equipment costs and the resulting power production costs. (LEW)

1607 Tidal Power Plants

435 **(DOE/R2/05166—T1) Tidal energy project for application in the East River, New York.** (Adelphi Univ., Garden City, NY (USA). Center for Energy Studies). Sep 1982. Contract FG42-80R205166. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000472.

Work is reported on design and field testing of Savonius rotors for use in generating electricity from tidal energy in the East River of New York. Several versions of the Savonius rotor were studied, as well as a vertical-axis rotor with swinging vanes. (LEW)

1608 Wave Energy Converters

436 **(DOE/R1/25251—T1) Non-linear control of the "clam" wave energy device. Final report.** (Applied Science Associates, Inc., Wakefield, RI (USA)). 1 Sep 1983. Contract FG41-81R125251. 46p. (RI—81-005). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000365.

A promising wave energy device being currently investigated is the "clam" device. The clam extracts energy by pumping air through a specially designed (Wells) turbine. Although operation of the Wells turbine does not require a rectified air flow, some additional control will be necessary to optimize the phase of the clam motion for good efficiencies. An examination of the equation of motion in the time domain suggests the possibility of non-linear phase control by mechanical, power take-off, or pneumatic latching. Latching can be shown to increase the efficiency of the device in the longer wavelengths of the wave spectrum, i.e. those of high incident wave power.

17 WIND ENERGY

1701 Availability (climatology)

437 **(DOE/SF/11620—T1) Wind farm feasibility analysis for the Hoopa Valley Indian Reservation. Final report.** (Hoopa Valley Business Council, Hoopa, CA (USA). Planning Dept.). 15 Jun 1983. Contract FG03-81SF11620. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86000352.

Three sites were selected out of 20 sites initially screened for the study. One of the three sites, Site No. 2 on Bald Hill, provided reliable data using a Helion Model 50 Microprospector. The other two sites provided marginal or no useful data. Results of the wind energy analysis showed that the Hoopa Valley is a highly sheltered area which does much to lessen any local winds. The narrow valley, with its high forested surrounding hills, effectively cuts off much of the wind. Over the course of the year, the only winds that can potentially provide energy, are those that are associated with winter and early spring storms. Late spring and summer winds are nearly useless for power generation. The amount of time with a wind speed greater than 5 m/s (11.12 MPH) was only 9% of the total study time. The amount of power that could potentially be generated at the Bald Hill site was calculated for a 25 kW W.E.C.S. (about 2500 kW-h per y) and for a 200 kW W.E.C.S. (about 10,000 kWh per y). The cost of producing that power was estimated at $1.10 and $1.38 per kW-h, respectively. These power costs do not warrant the purchase of a W.E.C.S. unless special circumstances were present. It was recommended that the Helion sensor be used at other potential sites in the area to provide more recorded data for a better wind energy conversion site. Alternate sources of energy should also be studied in the area, including hydropower, and timber-burning technologies.

438 **(PNL—5566) Improving the performance of mass-consistent numerical models using optimization techniques.** Barnard, J.C.; Wegley, H.L.; Hiester, T.R. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001224.

This report describes a technique of using a mass-consistent model to derive wind speeds over a microscale region of complex terrain. A serious limitation in the use of these numerical models is that the calculated wind field is highly sensitive to some input parameters, such as those specifying atmospheric stability. Because accurate values for these parameters are not usually known, confidence in the calculated winds is low. However, values for these parameters can be found by tuning the model to existing wind obeervations within a microscale area. This tuning is accomplished by using a single-variable, unconstrained optimization procedure that adjusts the unknown parameters so that the error between the observed winds and model calculations of these winds is minimized. Model verification is accomplished by using eight sets of hourly averaged wind data. These data are obtained from measurements made at approximately 30 sites covering a wind farm development in the Altamont Pass area. When the model is tuned to a small subset of the 30 sites, an accurate determination of the wind speeds was made for the remaining sites in six of the eight cases. (The two that failed were low wind speed cases.) Therefore, when this technique is used, numerical modeling shows great promise as a tool for microscale siting of wind turbines in complex terrain.

439 **(STEV-VIND—84-15) Wind measurements by SODAR at Nidingen.** Kvick, T. (Statens Energiverk, Stockholm (Sweden)). Jan 1984. 19p. (In Swedish). (SMHI-MK—1984-3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752723.

Data from the measurements of six months' duration are reported. The measuring method and the instrumentation are described. A preliminary evaluation and comparison with other methods for the measurement of wind speed are presented.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 346

440 **(DOE/EP/29182—15) Wake velocity deficit measurements at the Goodnoe Hills MOD-2 site: a summary of the 1982 and 1984 findings.** Baker, R.W.; Walker, S.N. (Oregon State Univ., Corvallis (USA). Wind Resources Assessment Lab.). Aug 1985. Contract AC79-81BP29182. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85018284.

The wake velocity deficits and turbulence levels measured behind the Goodnoe Hills MOD-2 2500 kW wind turbine generators using portable kite anemometers are described in this report. The measured deficits are compared to those calculated from two different wake models as well as to those measured by other research scientists at the Goodnoe Hills test facility.

441 **(DOE/BP/29182—16) Northeast Nevada wind resource assessment study.** Baker, R.W.; Wittrup, R. (Oregon State Univ., Corvallis (USA). Wind Resources Assessment Lab.). Aug 1985. Contract AC79-81BP29182. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85018285.

The wind power potential at all of the satellite sites around Pequop Summit was poor as the mean annual wind speeds were only in the 8 to 12 mph range and the mean power density values were well below 200 W/m^2. Only the Pequop Summit site had good wind power potential, especially during the winter and spring months. It appears that in northeast Nevada good winds are only found at well exposed north/south oriented ridges that are at least at the 7000 ft (MSL) elevation and above the valley temperature inversions. The wind shear in the lowest 200 ft over the higher elevation ridgecrest areas (i.e., Pequop Summit) is small due to low level acceleration in the winds. At the lower elevation sites much higher wind shear was measured. Detailed estimates of the wind power potential in the Pequop Summit site area revealed that windfarms using horizontal axis machines could produce significant levels of energy on a seasonal and annual basis as the annual Capacity Factors varied from 0.28 to 0.30. However, the vertical axis turbine used only had an annual Capacity Factor of 0.14 since the rated speed was very high. From the estimated Pequop Summit land area availability it appears that a windfarm could consist of 30 Type A 2500 kW machines, 70 Type B 300 kW units, or 120 Type D 65 kW turbines. The estimated annual energy outputs for these windfarms vary from 20,400,000 kWh for the Type D units to 184,300,000 kWh for the Type A array.

442 **(DOE/NASA/20320—66) Improved stud configurations for attaching laminated wood wind turbine blades.** Faddoul, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1985. Contract AI01-76ET20320. 28p. (NASA-TM—87109). NTIS, PC A03/MF A01; GPO Dep. File Number DE86001613.

In order to improve joint strength for bonded studs in laminated wood structures (wind turbine blades) a series of designs was developed and tested. Each design systematically varied a parameter which was expected to have a significant effect on performance. The structural capability of each design was established based on tension-tension fatigue tests, and it was found that a stud with a concave tapered carrot design, bonded in place with an epoxy thickened with chopped carbon fiber, was the most effective design. Further improvements in joint performance could be made by augmenting the laminated wood with thin plies of carbon cloth (10 percent thickness buildup) in the area of the stud. Two designs were selected for further testing, which demonstrated that joint strengths approaching the membrane wood strength could be achieved. For a 3- by 3-inch wood block, an ultimate load exceeding 100,000 lbs could be introduced through a single bonded stud. For the same type of specimen in cyclic tension at an R-ratio of 0.1, the bonded studs were projected to have a fatigue life of 4×10^8 cycles at maximum loads of 30,000 lbs. For reversed axial fatigue, a reduction of 25 percent from these numbers was shown to be appropriate. These values represent an improvement of 100 percent over the stud designs used previously for laminated wood wind turbine blades. However, temperatures of 100°F with humidity at 100 percent in certain cases caused a loss of ultimate load capability approaching 35 percent and a loss of fatigue capacity approaching 50 percent. While this result may have been specimen-related, additional testing or a change in the epoxy resin system should be considered before using the bonded stud designs in hot, humid environments.

443 **(DOE/R0/00070—T1) White Mountain wind energy demonstration project report.** (White Mountain Cooperative Community, Wauconda, WA (USA)). [1985]. Contract FG06-79R000070. 49p. NTIS, PC A03. File Number DE86000462.

This report will cover four separate areas of the Wind Energy Project. These four areas are unit site selection criteria and location; unit and tower types; installation procedures and recommendations; wind and unit performance data.

444 **(DOE/R1/10345—T1) Augmented savonious wind plant. Final report.** Gardy, V. (Gardy (Victor R.), Shelburne, VT (USA)). 20 Feb 1982. Contract FG41-80R110345. 50p. (VT—80-008). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000371.

Purpose of this project was to design, fabricate, test and demonstrate a low cost, augmented savonius wind system. The system design was basically as planned in the proposal with several minor variations. However, test results indicate two minor design modifications for future systems. Fabrication was completed 4 months later than scheduled due to several frustrating situations; consequently, insufficient tests were conducted in time for this report. Project costs were as anticipated in the aggregate with some individual item variations. However, the demonstrated system cost as projected from the parts cost breakdown was about 50% higher than hoped at $7432. A complete design package of sketches was prepared. The net overall system rating as tested was conservatively estimated at 2.7 kW versus the 4.0 kW estimated. The system cost in 81 dollars is $7432 ($4721 material, $2710 labor) thus yielding a fabrication cost of $2752 per kW capacity.

445 **(DOE/R2/05041—T1) Wind driven power plant. Final report.** Rhoads, W.L. (Rhoads (Willard L.), Rochester, NY (USA)). 7 Jan 1981. Contract FG42-79R205041. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000501.

Purpose of this document is to describe the equipment and hardware purchased or fabricated using grant funds. As described in the original proposal, the funds were used to purchase some of the major components of the WIND DRIVEN POWER PLANT project. Included in this report are details on the propeller hub and drive train assemblies, alternator cluster, blade design and stress analysis, the change in storage battery type, and the windmill controller. The main body of the report contains a general description of the equipment and hardware along with photographs. The technical details are presented in the first three appendicies. The fourth appendix contains a list of formal presentations which, to date, has been the primary vehicle for providing information to the public. Also, included is a list showing the disbursement of grant funds.

446 **(DOE/R2/05146—T1) Vortex wind turbine.** Raymond, F.E. (Raymond (Frank E.), Grafton, NY (USA)). Oct 1981. Contract FG42-80R205146. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000482.

The Vortex Wind Turbine Project is intended to prove or disprove the viability of Vortex Air Inducement in a cross wind axis turbine of vertical design. Experimentation was cautiously pur-

sued with various models of proposed Vortex Wind turbines. A realization of the Vortex principle with other known devices, was incorporated throughout the search, for correct application to a cross-wind axis vertical turbine. Initial findings of structural design negatives, dominated much of the Vortex wind turbine work. The vertical axis turbine with a Vortex inducing housing indicated two major problems. The first area of structural concern is that the turbine design is such that many critical stress components are of a cantilever type. The second area of concern is that a housing needed to produce the proper anticipated Vortex action is costly. The effectiveness of Vortex action in a cross-wind vertical turbine has not as yet been established.

447 **(DOE/R9/50040—T1) Development of a Magnus Air Turbine. Final report, September 1, 1980-September 1, 1983.** Hanson, T.F. (Hanson (Thomas F.), Newhall, CA (USA)). Aug 1983. Contract FG03-80R950040. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000344.

A 55 ft diameter Magnus Air Turbine (MAT) rated at 150kW was fabricated, erected, and operated. This grant project is one phase of a continuing program to develop a modern, commercially viable MAT. A MAT is a horizontal axis windmill in which the conventional airfoil shaped blades are replaced by slender cylinders that spin about their longitudinal centerlines. Previous studies had indicated that the MAT concept possessed several unique characteristics such as very low cost of manufacture, reduced vulnerability to damage by very high wind speeds, long fatique life, and simplicity in designing turbines tailored to specific and unusual site characteristics. This is only the second large MAT ever constructed, and the first in almost 60 years. This large experimental windmill was fabricated and erected at an equivalent cost of about $700/kW or $15/lb. These costs include a large un-reimbursed labor contribution by Windfree. While the MAT was successfully operated, wind conditions at the mountaintop test site proved to be inimical to the collection of credible performance data. The Southern California Edison Company has agreed to pay the cost of moving the MAT to their desert test area where testing of the MAT will be continued.

448 **(DOE/SF/11618—T1) Direct use of wind power for deep well pumping in irrigation. Final report.** Nebeker, E.B. (Scientific Associates, Inc., Santa Monica, CA (USA)). 15 Jun 1983. Contract FG03-81SF11618. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86000337.

A wind-hydraulic system was developed and tested which can transmit power from a wind turbine to the working shaft of an electrical motor. The system automatically controls the load on the turbine for optimum power capture as the wind speed varies. The system is relatively efficient in extracting power from the wind and constructively utilizing it. In comparison to conventional wind-electric devices, this system produces about 40% more power at and below rated wind speeds (22 to 25 mph) and over three times more power above rated speed. The ability to capture and utilize wind gust energy is an added benefit. Section II introduces the general characteristics of the system including the important role of the hydraulics and its transient performance characteristics. The specifics of system design are presented in Section III which includes selection of the wind turbine, design of hydraulic system, and other system features. Methods and rsults of testing are given in Section IV. This material indicates the system is performing as designed and is considerably more efficient in extracting and constructively utilizing wind energy than conventional wind-electric systems. A preliminary economic analysis of scale-up is discussed in Section V and indicates that the economics are quite favorable. For an ideal efficiency of extracting power from the wind of about 40%, this system extracts and effectively utilizes about 30%.

449 **(EPRI-AP—4288) EPRI wind turbine test activities, 1983-1984. Final report.** Schroeder, R.J.; Werthman, J.P. (Burns and McDonnell Engineering Co., Kansas City, MO (USA)). Oct 1985. 106p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920022.

Beginning in late 1982, the Electric Power Research Institute (EPRI) funded a series of test projects aimed at furthering wind turbine technology. The field tests involved wind turbines ranging in ratings from 0.05 MW to 4.0 MW. The major technical areas investigated were rotational sampling of wind velocity, structural loading analyses, fatigue life projection, performance and reliability evaluations, wind turbine wakes and environmental assessments. Contractors responsible for the testing and documentation of the tests were either utilities, wind turbine manufacturers, or wind industry consultants. A separate report was prepared by each contractor detailing the testing activities and results for each individual project. The results for all projects are summarized in this report.

450 **(NMERDI—2-73-4607) Field control power maximizer for small wind energy conversion systems. Final report.** Pahl, B. (SOLAC Builders Ltd., Albuquerque, NM (USA)). Sep 1985. 68p. NTIS, PC A04/MF A01 - NMERDI-Univ. of New Mexico, Suite M, 457 Washington, SE, Albuquerque, NM 87108. File Number DE86900092.

A microprocessor-based, real-time, closed-loop feedback power maximizing control system for Small Wind Energy Conversion Systems (SWECS) was developed. The control system senses only system power (volts x amperes) and allows the utilization of economical 3-phase AC alternators with DC fields. The control system may be immediately applied to other impedance matching problems, such as direct-coupled photovoltaic water pumping systems.

451 **(STEV-VIND—83-37) Gust structure and gust statistics. Results from an analysis of atmospheric turbulence measurements by using conditional sampling technique.** Linde, M. (Statens Energiverk, Stockholm (Sweden)). 1983. 57p. (FFA-TN—1983-28). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752733.

Gust structure and gust statistics of the atmospheric boundary layer have been investigated. Turbulence measurements from two different places and at heights up to 135 m above ground have been analysed by using conditional sampling technique. It is found that the atmospheric turbulence is not isotropic. Gusts with positive slope are more frequent when the turbulence intensity is high. The results indicate that the gust front line has a parabola-like shape in the horizontal plane. The gust frequency varies exponentially with amplitude in a fixed point in space. Considerable differences in gust frequency and gust amplitude are found when comparing the results for different levels above ground.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 1276, 1277

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 768

452 **(AD-P—004694/6/XAB) Damping properties of steam-turbine blades.** Rieger, N.F. (Stress Technology, Inc., Rochester, NY (USA)). Nov 1984. 32p. NTIS, PC A03/MF A01.

Material hysteresis, attachment friction and gasdynamic effects are recognized sources of damping in turbomachinery blading. No comparison study of their relative effectiveness appears to have been made, although there are diverse opinions on this topic. This overview paper describes a series of tests made to examine the damping properties of several types of steam-turbine blades. One objective was to determine the relative contributions from the above damping sources in these blade types. These studies were conducted in a non-rotating damping test rig that used blades mounted in corresponding real disk root attachments.

453 **(DOE/EIA—0479) Determinants of capital costs for coal-fired power plants.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 23 Oct 1985. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001921.

This report describes utility practices related to the estimation and realization of capital investment costs for new coal-fired generating units. This report focuses on coal-fired power plants; of

the 103 gigawatts of capacity additions planned for completion between 1985 and 1994 by the Nation's electric utilities, 44 gigawatts burn coal. The factors that affect capital investment costs are determined from four case studies. From a list of 88 coal-fired generating units that either entered service after 1981, or that are currently planned to enter service by the end of 1985, four units were chosen: Somerset, Unit 1 (New York State Electric and Gas); Sandow, Unit 4 (Texas Utilities); Hunter, Unit 3 (Utah Power and Light); and Parish, Unit 8 (Houston Lighting and Power). With the assistance of the utility companies named, information was collected during site visits that describes the accounting procedures, design, construction process, and cost estimating techniques for reporting capital investment costs for the construction of new coal-fired units. 10 figs., 11 tabs.

454 **(EPRI-AP—4162) Benefits of improved gas turbine reliability. Final report.** Wood, A.J. (Power Technologies, Inc., Schenectady, NY (USA)). Oct 1985. 146p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920023.

The objective of this project was the development of quantitative measures of the economic benefits of improvements in advanced gas turbine reliability in both an IGCC plant and a sample cycle peaking unit. Methods used to evaluate production cost savings are similar to those used in planning studies by electric utilities. These economic benefits were analyzed using the predominately coal and nuclear, West Central EPRI regional utility system. Advanced gas turbine performance parameters used are those anticipated to be available in gas turbine units in the 1990-1995 era with efficiencies based on firing temperatures in the range of 2200 and 2300°F. The economic results, based on 1993 conditions, indicate that there is a significant economic benefit for increasing gas turbine reliability. Calculated savings in 1993 dollars for an August day for the IGCC plant were $80,000 per forced outage event or $12.50 per MWh lost due to forced outages. The values for peaking unit were higher. Typical savings were $145,000 per event or $48.50 per MWh. These results may be used to evaluate the additional initial capital investment justified by the improved reliability of the gas turbines. 34 refs., 27 figs., 29 tabs.

455 **(EPRI-CS—4279) Condenser-targeted chlorination design. Final report.** Mussalli, Y.G. (Stone and Webster Engineering Corp., Boston, MA (USA)). Oct 1985. 300p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920027.

Existing chlorination practices and research were reviewed to identify possible targeted chlorination programs. In order to develop a generic design(s) that can fit most utilities, the engineering parameters that affect the inlet water box hydraulics and chlorine injection devices were identified. Several targeted chlorination designs (guide vanes, fixed nozzles, water lance jet, moveable manifold, and individual feed tubes) were designed conceptually and their advantages and disadvantages discussed. The capital and operating costs for each design were presented together with the benefits regarding the environment, performance, and reduced costs. The designs were ranked, based on a multi-objective decision making technique with over 30 professionals participating. Three designs were selected for further optimization in a 1:9.6 scale condenser model study. The fixed nozzles and the moveable manifold chlorine injection systems are potentially feasible for targeted chlorination.

456 **(KFK—3882) Boundary condition for the life fraction rule in order to determine the service lives under varying loading.** Schaefer, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). May 1985. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752711.

Previously the attempt has been made to improve the often inadequate accuracy of the life fraction rule (a. Robinson) applied to service lives under varying loading (temperature and stress) by introducing constants into the mathematical representation of the rule which take into account the influence of the material and the conditions of loading. As these 'constants' have to be calculated from experimentally determined service lives for the 'prediction' of which they are to be used, these calculations are merely a description of known experimental data and not a prediction of the service life under varying loading from data based on constant loadings. These descriptions can be generalized to a very limited extent only for making quasi-predictions related to very similar types of loading and materials. In this work description based on constants is dispensed with and only one boundary condition is indicated for the life fraction rule which is necessary and sufficient to calculate correctly any fractional damage and hence any service life under varying loading. The abbreviated wording of this boundary condition is: To calculate a fractional damage the life fraction must be divided by a service life the structural condition being the same. The specimen will rupture as soon as the sum of fractional damages has attained unity.

457 **(ORNL/TM—9735) Assessment of materials needs for advanced steam cycle coal-fired plants.** Rittenhouse, P.L.; Goodwin, G.M.; Graves, R.L.; DeVan, J.H.; Griess, J.C. Jr.; Judkins, R.R.; Swindeman, R.W. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001376.

Conventional steam power plants burning pulverized coal will make a large contribution to the nation's electric power generation for the next several decades. Improvements in the thermal efficiency of these plants will provide significant economic benefits. Improvements in thermal efficiency are possible through the use of steam cycles operating at higher temperatures and pressures than those presently used. Because steam conditions have generally been limited by materials capabilities, an assessment was made of the materials needs to permit design and construction of these advanced plants. Studies sponsored by the Electric Power Research Institute were reviewed and used as the basis for definition of various advanced plant concepts. Variations in major design parameters and the resulting effects on plant efficiencies are presented in detail, and the thesis is presented that increasing steam pressure and temperature, with the necessary concomitant materials development, is a logical focus of attention. The current status of plant technology was documented, and desirable advanced system characteristics were determined by interaction with numerous manufacturing and engineering organizations. The consensus is that the next generation of plants must be more efficient and must possess greater operating flexibility without the loss of plant availability. Materials-related concerns in advanced plants include long-time high-temperature strength and stability, fireside liquid-phase coal ash corrosion, and steamside oxidation and exfoliation. Other areas include characterization and codification of advanced alloys that are not now approved by the ASME Code, fabrication technology, turbine materials technology, and the technology of other materials-limited components such as valves, tube supports, and main reheat steam piping. 21 refs.

458 **Performance comparison between transpiration air cooled turbine 3000°F (1649°C) stator vanes and solid uncooled vanes.** Manning, G.B.; Moskowitz, S. *American Society of Mechanical Engineers, [Paper]*; **84-GT-121**: 7(Jun 1984). (CONF-840611—).

From International gas turbine conference and exhibit; Amsterdam, Netherlands (4 Jun 1984).

Testing was conducted to compare the aerodynamic performance of a turbine vane using transpiration air-cooling capable of operation at 3000°F (1649°C) gas temperature with a vane of identical profile with no cooling provisions to determine the effect of cooling on vane kinetic energy efficiency and loss coefficient. The test configuration was a 10-vane section of full scale first stage turbine stator annulus designed for 1.6 pressure ratio, cooling air flow equal to 6.1 percent of primary flow, 3000°F (1649°C) turbine inlet temperature and primary-to-coolant temperature ratio of 2.7. To enable comparison with other investigations, tests were conducted at three pressure ratios from 1.4 to 1.6, three coolant flows from 75 to 120 percent of design, and three primary-tocoolant temperature ratios from 2.70 to 1.15. Efficiency, loss coefficient and flow capacity test results were in good agreement with predicted values for both the transpiration air cooled and uncooled vanes. The testing demonstrated that it is necessary to conduct test evalua-

tions of transpiration air-cooled components at or near design coolant-to-gas stream temperature ratio in order to achieve correct results.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 48, 51, 52, 56, 77, 455, 1301, 1357

459 **(DES—74-12) Draft supplement to the environmental statement, fiscal year 1975 proposed program. Facility location evaluation for Raver-Tacoma 500-kV transmission line Study Area 74-5.** (USDOE Bonneville Power Administration, Portland, OR). 15 Feb 1974. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001835.

Proposed construction of a 9.5-mile 500-kV double-circuit line connecting BPA's Raver and Covington Substations. The new line would replace 3.0 miles of existing BPA 230-kV lines and would then parallel an existing 500-kV line for 5.3 miles. Removal of 112 acres of forest, and diversion of that land to nonforest uses compatible with the transmission line right-of-way. Disturbance of game in the immediate vicinity of the route during construction, some soil erosion primarily during and immediately after construction, siltation in nearby streams, disturbance of nearby residents from noise and dust during construction, and some degradation of AM reception immediately adjacent to the right-of-way.

460 **(DOE/EIS—0005-DS) Bonneville Power Administration proposed Fiscal Year 1979 Program. Facility location supplement. San Juan Islands area service, 115-kV submarine transmission cable. Draft supplement. Final environmental impact statement.** (Department of Energy, Washington, DC (USA)). May 1980. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001833.

This document describes a proposal for transmission facilities to serve the San Juan Islands. The proposal consists of four subprojects: (1) a 4.5 mile (7.5 km) 115-kV submarine cable across Rosario Strait from Fidalgo Substation on Fidalgo Island to the eastern shore of Decatur Island; (2) a 1.5 mile (2.5 km) 115-kV underground cable across Decatur Island; (3) a 2.2 mile (3.5 km) 115-kV submarine cable across Lopez Sound from the western shore of Decatur Island to the Lopez Substation on the eastern shore of Lopez Island; and (4) replacement of 800 ft. (244 m) of double-circuit wood-pole overhead line with two 34.5-kV underground cables on the eastern side of Decatur Island to move the existing terminal structure inland.

461 **(DOE/EIS—0048-DS-1) Bonneville Power Administration proposed Fiscal Year 1976 Program. Facility location. Okanogan area service, Douglas, Okanogan, Grant and Lincoln Counties, Washington. Draft supplement. Final environmental impact statement.** (Department of Energy, Washington, DC (USA)). May 1979. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001834.

This document describes a proposal for transmission facilities to serve the Okanogan Valley. The original need for additional energy was determined in 1973 and discussed in a location supplement to the Fiscal Year 1976 Program Environmental Statement. Issues pending between the Colville Business Council and the US Government have deferred the project since that time. BPA reliability standards have not been met and electrical loads have continued to increase since 1975. BPA has determined that it can no longer defer this project. This document presents a proposal differing from the original Location Supplement (1976) and the reasons for the change. The original proposed location (Route B) has been eliminated because of an unresolved right-of-way dispute with the Colville Indian Reservation. The previous location supplement discussed four other alternative routes in addition to Route B (Routes A, C, D, and E). The current location supplement discusses two alternative routes which would satisfy the plan of service. These routes are Route A (the new proposed route) and Route B (the previous proposed route). Although Route B has been eliminated, it is discussed here so that reviewers may compare it with the new proposal. The three remaining routes previously identified in the earlier location supplement (routes C, D, and E) are not given full coverage here as they have been determined not feasible for environmental and/or engineering reasons.

462 **(DOE/PC/60264—T2) Development of a combined NO/sub x//SO_2 removal system based on ZnO scrubbing technology. Fifteenth monthly technical progress report, August 1-August 31, 1985.** Rosenberg, H.S.; Nuzum, H.K. (Battelle Columbus Labs., OH (USA)). 15 Sep 1985. Contract AC22-83PC60264. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018298.

Work continued on cycling ZnO between absorption and regeneration. A material balance accounted for recovery of about 50 to 70% of both the SO_2 and NO/sub x/. Acid condensation between the reactor and the analyzer may account for the losses. However, there was a loss in ZnO reactivity after each regeneration cycle (heating to 1400°F) even with in situ stirring of the bed between cycles. The desorption curves for SO_2 and NO/sub x/ indicate the presence of sulfite, sulfate, and nitrate. However, it is possible that a sulfur-nitrogen compound is also present because the NO/sub x/ peak occurs at about the same temperature as one of the SO_2 peaks. Also, infrared analysis indicates the presence of a sulfur-nitrogen compound and/or a sulfur compound such as dithionate.

463 **(EPRI-CS—4277-SR) SO_2 and NO/sub x/ Retrofit Control Technologies Handbook.** Miller, M.J. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA). Coal Combustion Systems Div.). Oct 1985. 397p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920028.

The objective of this report is to assist utility decisionmakers in the selection and costing of retrofit NO/sub x/ and SO_2 controls on coal-fired boilers. In short, technical discussions of commercial and near-term (five to ten years) retrofit control technologies for NO/sub x/ and SO_2 are presented. Each technology is discussed in terms of its operation, commercial status, range of applicability, field experience, economics, critical issues for operation, and prognosis for future use. In addition to the technical summaries, this report contains chapters on guidelines for estimating FGD retrofit costs for six FGD technologies, guidelines for estimating costs of FGD byproduct disposal, and a summary of EPRI's economic evaluation process. 120 figs., 63 tabs.

464 **(FES—77-6) Final Environmental Statement, fiscal year 1978 proposed program.** (USDOE Bonneville Power Administration, Portland, OR). 8 Mar 1977. 304p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86001837.

Summary of environmental impact and adverse environmental effects: The Fiscal Year 1978 Proposed Program would result in the permanent removal of approximately 10 acres of vegetative cover; the removal of up to 6 acres of cropland from production; visual impacts to three scenic roadways; disturbance of topsoil, temporary wind and water erosion, and a resultant increase in siltation and turbidity in numerous small and intermittent streams with possible consequential temporary adverse effects on fish mortality and sqawning habitat; the introduction of particulates and combustion byproducts into the atmosphere during open burning of slash; introduction of herbicides into the environment; temporary reduction in wildlife habitat due to herbicides and clearing operations; audible noise during operation of construction equipment and transmission lines and substations; increased risk of man-caused accidents; and maintenance of a high standard of living and level of productivity for the Pacific Northwest through continued availability of reliable electric service.

465 **DOE seeks low-cost, retrofit SO_2 control method.** *Electric Light and Power;* **63**: No. 10, 33, 35(Oct 1985).

DOE is funding the development by four companies of a low-cost way to lower sulfur dioxide SO_2 emissions from power plants to be ready in case emission controls are required. The program seeks methods for removing 50-70% of SO_2 for less than $500 per ton. Conventional scrubbers remove 90% at $800-$2000 per ton. The approach is to inject reagents into the flue gas stream behind the boiler. One approach, the HALT method, adds hydrated lime at low temperature and collects solid calcium sulfate in the precipitator with the fly ash. With a goal of 80% removal, HALT is ready for demonstration. Other efforts include lime injection and in-duct spray drying techniques using atomized lime slurries. The

TUNG process produces salable liquid SO_2, sulfuric acid, or elemental sulfur and reduces steam costs, but requires a separate scrubbing vessel.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 342, 345, 1278, 1279

466 **(BNL—36743) Development of superconducting power transmission technology.** Forsyth, E.B. (Brookhaven National Lab., Upton, NY (USA)). [1985]. Contract AC02-76CH00016. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85016054.

Superconducting power transmission cables are the latest innovation in a technology which is as old as electric power engineering. The construction of central electricity generating stations by Thomas Edison in the USA and Sebastian Ferranti in England in the 1880's immediately posed the problem of how customers could be connected to the power source. Distribution by means of wires suspended from poles was tried briefly but the densely populated areas chosen as sites for the early generators soon forced the distribution system underground. Edison's low voltage dc system was a technological dead-end but by 1890 Ferranti had built a 7 mile-long underground cable system from the generating plant at Deptford to central London which operated at the then unprecedented level of 10,000 V, alternating current. Ferranti was remarkably prescient in his choice of wrapped brown paper for the cable insulation, a material which has continued to be used in this application until the present day. Paper was chosen for the insulation because it gave good operating performance at low cost compared to other insulating materials then available, such as rubber and gutta percha. Economic considerations must be weighed carefully in the design of underground power transmission systems and they have been a compelling factor in the pattern of development from the turn of the century to the advanced superconducting systems under test in the 1980's.

467 **(EPRI-EL—4186) Fault current limiters: laboratory investigations. Final report.** Dollinger, R.; Dettman, D.R. (State Univ. of New York, Buffalo (USA). Dept. of Electrical and Computer Engineering). Oct 1985. 139p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920025.

The increasing risk of high fault currents has created a need for fast-acting fault current limiters (FCLs). Laboratory experiments described in this report provided information for the development of an FCL using vacuum arc technology.

468 **Behaviour of three-node power networks.** Arapostathis, A.; Varaiya, P. (Department of Electrical Engineering and Computer Sciences and Electronics Research Laboratory, University of California). *International Journal of Electrical Power and Energy Systems;* **5**: No. 1, 22-30(Jan 1983).

The real power-flow equation for a three-node network is analysed in terms of its topology and geometry. It is shown that the set of feasible power injections is convex and that, for each feasible injection, there is a corresponding unique stable solution. Certain aspects of the behaviour of the associated swing equations are studied. This behaviour is quite different from that of a two-node network; in particular, the system may not be completely stable even when the damping is made arbitrarily large.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 233

469 **(AD—447872/3/XAB) Theoretical and experimental analysis of availability in nuclear power plants. Technical report, 1 March 1963-1 May 1964.** (AMF Atomics, Greenwich, CT (USA)). Aug 1964. 267p. NTIS, PC A12.

The method of generating functions is used to calculate the probability of successful operation of a nuclear power plant for given fractions of the desired cycle time. A digital computer program is provided to carry out the necessary computations. The actual performance of the PM-1 reactor is analyzed using the events that have caused the plant to shut down in the past. Suggestions for improving this performance are also made. Failure and repair data obtained are used in the computing code for illustration. The outline of a proposed Nuclear Power Plant Availability Handbook is included to illustrate the topics which would be covered and their arrangement.

470 **(BMI—1984-063) Analysis and evaluation of status reports for quality assurance practice in nuclear power plant construction.** (Bundesministerium des Innern, Bonn (Germany, F.R.); ORG-Consult Gesellschaft fuer Unternehmensberatung m.b.H., Essen (Germany, F.R.)). Dec 1984. 156p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85752721.

The study elaborates the structure and definitions of a general description of quality assurance systems with respect to planning and construction of nuclear power plants and indicates standards concerning the production and adaption of structural components. It is suggested to introduce in the licensing procedure the so-called comprehensive constructional report by an expert. For contractors, tasks and responsibilities of the major companies with regard to quality assurance are expressly stipulated. The study also suggests the inclusion of ARGEN, the elaboration of production and test sequence plans and the introduction of a control and evaluation system for the feedback of experience among companies involved and ARGEN.

471 **(CEA-CONF—7845) Testing tool for software concerning nuclear power plant safety.** Boulc'h, J.; Le Meur, M.; Collart, J.M.; Segalard, J.; Uberschlag, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 8p. (In French). (CONF-841168—1; DAS—126). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752885.

From Specialists' meeting on use of digital computing devices in systems important to safety; Saclay, France (28 Nov 1984).

In the present case, softwares to be analyzed are all written in assembler language. This paper presents the study and the realization of a tool to analyze softwares which have an important role for nuclear reactor protection and sauvegarde: principles of the tool design, working principle, realization and evolution of dynamic analyze tool.

472 **(INIS-mf—9910-Vol.1) Canadian Nuclear Society 4. Annual Conference 1983, June 15. Proceedings. Vol. 1.** (Canadian Nuclear Society, Toronto, Ontario). 1983. 495p. (CONF-830660—Vol.1). NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088.

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Individual papers were processed.

473 **(INIS-mf—9910-Vol.2) Canadian Nuclear Society 4. Annual Conference 1983, June 15. Proceedings. Vol. 2.** (Canadian Nuclear Society, Toronto, Ontario). 1983. 528p. (CONF-830660—Vol.2). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089.

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Individual papers were processed.

474 **(ORNL/TM—9559) Developing a computer-based environment for the design of nuclear power plants: a perspective and philosophy.** Brey, H.; Kisner, R.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001446.

This report surveys the usefulness and general design requirements for a large-scale database and database manager for design and analysis of nuclear power plant control systems. The control engineer's and systems integrator's need for timely, accu-

rate, and searchable information for advanced control system design increases with competitive economics and stringent reliability demands. A philosophy is conveyed for the implementation of an integrated, comprehensive database system.

475 **(PB—85-223030/XAB) National strategies for nuclear power reactor development. Executive summary.** Lester, R.K.; Driscoll, M.J.; Golay, M.W.; Lanning, D.D.; Lidsky, L.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Mar 1985. 48p. (MITNPI-PA—002-ES). NTIS, PC A03/MF A01.

The document assesses the potential for design innovation in three areas of nuclear power plant technology: light-water reactor systems; liquid metal reactor systems; and high-temperature-gas reactor systems. The question of how capital costs scale with unit size in nuclear power reactor systems is addressed. Small modular high-temperature-gas reactor designs are reviewed, and an electric-power-system capacity planning model that allows estimates to be made of the economic implications of construction lead time and power rating variations for utility ratepayers and shareholders is presented. The effects of industrial reorganization and structure on the economic performance of the nuclear power industry in the U.S. is explored, and options available to the Nuclear Regulatory Commission for establishing the general philosophy, technical criteria, and organizational approach to the regulation of a new generation of nuclear power plants are discussed. Light-water reactor systems are determined to be the only plausible technical option if nuclear power is to figure in the capacity expanson plans of U.S. electric utilities in the near term.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 153, 160, 162, 497, 573, 577, 581, 595, 608, 609, 610, 612, 613, 616, 617, 618, 620, 621, 622, 623, 624, 625, 627, 628, 629, 630, 631, 632, 633, 634, 636, 637, 638, 639, 640, 642, 643, 644, 659, 661, 662, 663, 664, 666, 667, 669, 670, 671, 672, 673, 677, 678, 679, 680, 681, 687, 701, 705, 706, 710, 711, 727, 729, 736, 752, 1352

476 **(CONF-850610—34) Process-inherent, ultimate-safety (PIUS) boiling-water reactor.** Forsberg, C.W. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85016403.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

A new type of boiling-water reactor (BWR) has been conceived - the Process-Inherent, Ultimate-Safety, Boiling-Water Reactor (PIUS BWR). The proposed design described in this report extends the PIUS design philosophy from pressurized-water reactors (PWRs) to BWRs. In a PIUS BWR, safety systems are passive, with no active components. The reactor core and nonnuclear portion of the plant are similar to current BWR designs, but a special, prestressed concrete reactor vessel (PCRV) with a unique internal design replaces the conventional pressure vessel, emergency core cooling systems, containment shell, spent-fuel storage ponds, diesel generators, and most other components of the nuclear island.

477 **(CONF-8510159—1) Characterization of acoustic emission signals generated by water flow through intergranular stress corrosion cracks.** Claytor, T.N.; Kupperman, D.S. (Argonne National Lab., IL (USA)). May 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01 - GPO. File Number TI85014970.

From 2. international conference on acoustic emission; Lake Tahoe, NV, USA (28 Oct 1985).

A program is under way at Argonne National Laboratory (ANL) to develop an independent capability to assess the effectiveness of current and proposed techniques for acoustic leak detection (ALD) in reactor coolant systems. The program will establish whether meaningful quantitative data on flow rates and leak location can be obtained from acoustic signatures of leaks due to intergranular stress corrosion cracks (TGSCCs) and fatigue cracks, and whether these can be distinguished from other types of leaks. 5 refs., 3 figs.

478 (EPRI-NP—4113-SR, pp 18.1-18.15) **Simple model for predicting fission-gas release in LWR fuel rods.** Tasooji, A.; Gehl, S. (Stanford Univ., CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

A simple empirical model to predict fission-gas release (FGR) in irradiated uranium dioxide fuel is developed. The model is capable of predicting FGR at burnups of up to 60 Gwd/T. The model development is the outgrowth of an investigation of the relative importance of temperature, microstructure, and burnup in determining FGR. The methods used for the calculation of the temperature distribution in high burnup fuels are discussed. The model has been used to independently predict the data from various sources. This success in modeling the data suggests that the present model can be used in predicting fuel element performance. The results indicate that FGR is a strong function of temperature. However, no explicit dependence of FGR on burnup has been found.

479 **(ORNL/TM—9601) Browns Ferry-1 single-loop operation tests.** March-Leuba, J.; Wood, R.T.; Otaduy, P.J.; McNew, C.O. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001438.

This report documents the results of the stability tests performed on February 9, 1985, at the Browns Ferry Nuclear Power Plant Unit 1 under single-loop operating conditions. The observed increase in neutron noise during single-loop operation is solely due to an increase in flow noise. The Browns Ferry-1 reactor has been found to be stable in all modes of operation attained during the present tests. The most unstable test plateau corresponded to minimum recirculation pump speed in single-loop operation (test BFTP3). This operating condition had the minimum flow and maximum power-to-flow ratio. The estimated decay ratio in this plateau is 0.53. The decay ratio decreased as the flow was increased during single-loop operation (down to 0.34 for test plateau BFTP6). This observation implies that the core-wide reactor stability follows the same trends in single-loop as it does in two-loop operation. Finally, no local or higher mode instabilities were found in the data taken from local power range monitors. The decay ratios estimated from the local power range monitors were not significantly different from those estimated from the average power range monitors.

480 **(PB—85-208288/XAB) Health hazard evaluation report HETA 84-437-1532, Perry Nuclear Power Plant, Perry, Ohio.** Moseley, C.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Nov 1984. 22p. (HETA—84-437-1532). NTIS, PC A02/MF A01.

Breathing-zone samples were analyzed for iron, zinc, lead, nickel, and chromium fumes, quartz, cristobalite, and respirable particulates during construction of the Perry Nuclear Power facility, Perry, Ohio in August, 1984. The survey was requested by Local 210 of the Pipefitters Union to evaluate exposure of airborne contaminants to construction workers at the facility. All metal fume and respirable particulates were well below the relevant standards. The author notes that NIOSH conducted two previous surveys at the site and the concentrations of all contaminants have decreased since work has progressed at the facility. The quartz overexposure is due to residual construction dust. Each contractor should assume responsibility for the health and safety of his employees. Break areas should be vacuumed daily. Good housekeeping practices should be maintained in all areas to prevent exposure to quartz dust.

481 **Twelfth biennial conference on reactor operating experience maintenance and modifications for availability and efficiency.** La Grange Park, IL; American Nuclear Society Incorporated (1985). 74p. (CONF-850894—).

From 12. biennial conference on reactor operating experience "maintenance and modifications for availability and efficiency"; Williamsburg, VA, USA (4 Aug 1985).

Separate abstracts were prepared for the papers presented in the following topical sessions: (1) Formal Availability Improvement Programs; (2) Maintenance Aids and Diagnostics; (3) Nuclear Plant

Inspection and Testing; (4) Secondary Cycle Improvement to Programs; (5) Recent Plant Experiences; (6) Training, Research, and Test Reactors; (7) Impact of Plant Maintenance on Availability; (8) Intragranular Stress Corrosion Cracking: Repair, Inspection, and Mitigating Techniques; (9) Availability Improvement - Recent Development and Trends; (10) Water Chemistry and Corrosion Control; and (11) ALARA: Experiences with Dose Reduction.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 153, 160, 162, 477, 478, 481, 576, 577, 578, 597, 598, 599, 600, 601, 606, 607, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 669, 670, 671, 672, 677, 678, 679, 680, 681, 684, 687, 688, 699, 700, 705, 706, 710, 711, 712, 731, 732, 735, 736, 737, 742, 743, 744, 752, 880, 1016, 1309

482 **(CEA-CONF—7466) Neutron transport by TRIPOLI-2 code in the lower part of a PWR pit and in the pit-access cell.** Vergnaud, T.; Bourdet, L.; Gonnord, J.; Nimal, J.C.; Champion, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1984. 10p. (CONF-840901—26). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752827.

From ANS topical meeting on reactor physics and shielding; Chicago, IL, USA (17 Sep 1984).

The neutrons, which exit the reactor vessel, leak between the reactor vessel and the primary concrete shield and provide high dose rate in the lower part of the reactor pit. In this part of the reactor the biological shield is reduced at the level of the pit-access cell door and of the ventilation duct. Consequently there is a pinpoint increase of dose rate at reactor place where access must be free during power operation. Studies concern 900 MWe and 1300 MWe plants; calculation results are compared with dose rate measurements which have been done at several interesting points of reactor. Neutron transport is studied in two steps: - first Monte Carlo calculation carried out by the TRIPOLI-2 system gives the current of neutrons entering into the pit-access cell; - a second calculation is about neutron transport in this cell; it is also performed with the TRIPOLI-2 code which uses a very realistic model for cell geometry. Then the door efficiency is evaluated by a SN one dimension code.

483 **(CEA-CONF—7491) Joint program for the improvement of bimetallic weld inspection.** Serre, M.; Rattoni, B.; Coquillay; Samman; Billet; Bodson; Olivera. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1985. 5p. (CONF-850112—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752821.

From 7. international conference on nondestructive evaluation in the nuclear industry; Grenoble, France (29 Jan 1985).

The aim of this program is to improve the in-service monitoring of austenitic and bimetallic welds in PWR Main Coolant Systems. This paper presents the work performed on the bimetallic weld connecting the safe end to the reactor vessel nozzle: suitability of ultrasonic testing for determining the size and location of defects, automation and calibration, gamma-ray examination in three different planes.

484 **(CEA-CONF—7492) Joint program on detection and sizing of defects (PWS 7.701).** Benoist, P.; Pigeon, M.; Samman; Salin; Pade; Bodson; Renaud. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1985. 3p. (CONF-850112—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752820.

From 7. international conference on nondestructive evaluation in the nuclear industry; Grenoble, France (29 Jan 1985).

Within the framework of the cooperation between Westinghouse, EDF, CEA and FRAMATOME, a Round Robin Test was conducted on six ferritic steel test blocks in which defects were artificially induced in the welds, in order to improve the different methods for detection and sizing used in ultrasonic testing in the shop and on site. The first results on one of the blocks are given here.

485 **(CEA-CONF—7493) Nondestructive testing of PWR type fuel rods by eddy currents and metrology in the OSIRIS reactor pool.** Faure, M.; Marchand, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1985. 8p. (In French and English). (CONF-850112—9). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752826.

From 7. international conference on nondestructive evaluation in the nuclear industry; Grenoble, France (29 Jan 1985).

The Saclay Reactor Department has developed a nondestructive test bench, now installed above channel 1 of the OSIRIS reactor. As part of investigations into the dynamics of PWR fuel degradation, a number of fuel rods underwent metrological and eddy current inspection, after irradiation.

486 **(CEA-CONF—7530) Diagnosing the vibrating behaviour of the PWR internal structures using expert systems techniques and algorithmic treatment.** Carre, J.C.; Gibert, R.J.; Kavenoky, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1984. 7p. (In French). (CONF-841017—12). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752828.

From Specialists' meeting on reactor noise - SMORN IV; Dijon, France (15 Oct 1984).

In order to automate the diagnostic of the vibrating behaviour of PWR internal structures, a program based on the expert system technology is added to the present time numerical software, the calculation comprises three stages: the signal is first processed with a Fourier transformation, then with a quadrature and an average thus giving the Noise Power Spectral Density. From this function a few characteristic resonances (between 5 and 10) are extracted and transmitted to the expert software.

487 **(CEA-CONF—7685) Study of corrosion product release of materials in primary coolant circuits of pressurized water reactors.** Darras, R.; Courvoisier, P.; Dolle, L.; Parisot, J.; Favennec, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Nov 1984. 3p. (In French). (CONF-8411178—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752890.

From 13. working group meeting on nuclear corrosion; Roma, Italy (8 Nov 1984).

With the aid of two devices, named "ECRINS", the influence of several factors on the "release ratios", particularly cobalt ratio, is studied.

488 **(EPRI-NP—4287) Assessment of PWR waterside corrosion models and data. Final report.** Cox, B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1985. 114p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920017.

The published data on waterside corrosion of PWR fuel cladding and unfuelled components have been reviewed, and the models used to assess the data have been studied. All corrosion models use too simplified a view of the corrosion process to obtain other than a general trend for the actual oxidation data. The in-reactor post-transition oxidation of the Zircaloys appears to be heavily dependent on water chemistry variations both between reactors, and along the length of an individual fuel rod. Crud deposition may be one primary cause of this, perhaps by allowing the independent development of the water chemistry within the crud layer, as much as by its effect on cladding surface temperatures. However, the effect of the thickening of the oxide film, which permits the development of an independent water chemistry inside the oxide, leading to an accelerating oxidation rate at large oxide thicknesses, seems to be the most important factor. It is concluded that a spectrum of results ranging from essentially no in-reactor enhancement of the oxidation rate to a sizeable enhancement (>10) may be seen depending upon the thickness of the oxide films, the water chemistry of the reactor, and crud deposition. A post-irradiation test that may help to distinguish between the factors involved has been suggested. 105 refs., 38 figs.

489 **(FRA—142-2) Two metals welded joints analysis. Specific problems and solution proposal.** Bodson, F.; Launay, J.P.; Thomas, A. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Mar 1983. 7p. (In French). (CONF-830330—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752863.

From IAEA conference on reliability; Stuttgart, F.R. Germany (21 Mar 1983).

This paper summarizes the non destructive quality control of bimetallic welded joints on pipes and metallic structures of PWR type reactors (1300 MWe): radiographic and metrasonic failure detection, standardization and in service control processes.

490 **(FRA—143-1) Fast diagnosis and treatment of cracklike defect injuriousness in PWR power plant equipment.** Benchimol, M.; Boneh, B.; Gilles, P. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Aug 1983. 8p. (CONF-830805—102). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752871.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

Defects detected in nuclear power plant components in the course of periodic inspections may have been formed during fabrication, at installation or in service. In order to accelerate decision-making subsequent to defect detection and increase the effectiveness of inspection programs, it is proposed in this paper that a package be prepared for each main system at the design stage to permit immediate diagnosis of defect injuriousness and to offer guidelines for mitigating action. The paper comprises: description of such a package, hereafter referred to as "Defect Injuriousness Diagnosis and Treatment Package" (DIDTP); breakdown of a DIDTP and demonstration of the computational methods used in its elaboration; presentation of the computer codes (ANODE, TITAN) used for automatic compilation of DIDTP's; example of DIDTP application.

491 **(FRA—143-2) Dynamic stability analysis of spring loaded safety valves element for improved valve performance through assistance device.** Catalani, L. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Aug 1984. 7p. (CONF-830805—99). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752848.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

For a given valve design (internal profile and ring setting) the dynamic performance, which depends strongly on the piping t/h response, can be judged only in terms of a coupled problem between valve and piping hydraulic transient. To fulfill this aim an analytical model was developed (valve dynamic model coupled with an existing thermal-hydraulics code for the upstream piping) that provides the means to assess the influence of the main parameters on the valve stability: ring setting, upstream fluid conditions (vapour or liquid discharge), upstream piping length (between presurizer and safety valves). At last, the performance of a spring loaded safety valve may be greatly improved by the introduction of a pneumatic or electromagnetic assistance device.

492 **(FRA—147-1) Nuclear power plant equipment design and construction rules.** Boiron, P. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Mar 1983. 3p. (In French). (CONF-8303148—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752866.

From Meeting on standardization of nuclear power plant design and construction; Paris, France (23 Mar 1983).

Presentation of the AFCEN (French association for nuclear power plant equipment design and construction rules) working, of its edition activity and of somes of its edited documents such as RCC-C (design and construction rules for PWR power plant fuel assemblies) and RCC-E (design and construction rules for nuclear facility electrical equipments).

493 (INIS-mf—9905, pp 113-119) **Acoustic testing of reactor pressure vessel using Reactor test TRC equipment.** Prepechal, J.; Skala, Z. (Skoda, Plzen (Czechoslovakia)). 1983. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091. (CONF-8310399—).

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

Acoustic testing of welded joints, austenitic overlay and the basic material of the pressure vessel body is carried out using a four channel ultrasonic instrument to which are connected ultrasonic probes with different specifications. The probes are specialized in detecting faults in welded joints, cracks under overlays and defects at the boundary of overlay and basic material. The ultrasonic instrument also contains an analog part which consists of the usual circuits, and control and evaluation parts.

494 **(NUREG/CR—4361) Steam Generator Group Project. Annual report, 1983.** Clark, R.A.; Lewis, M. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 125p. (PNL—5017). NTIS, PC A06/MF A01 - GPO. File Number TI86002178.

The Steam Generator Group Project (SGGP) is an NRC program jointly funded by consortia from France, Italy and Japan, and the Electric Power Research Institute. The SGGP utilizes a steam generator removed from service at a nuclear plant as a vehicle for research on a variety of safety and reliability issues. This report is an annual summary of progress on the program for 1983. Information is presented on the task of removing 969 plugs by drilling them out of the tubes in the steam generator to permit access for eddy current nondestructive testing probes. A description is given of two post-service baseline eddy current inspections, one by Zetec and one by Intercontrole, of about 3000 tubes. Photographic documentation is provided of damage observations on the secondary side of the unit. Corrosion coupon results are reported from the channel head decontaminations described in the 1982 annual report. Plans for further eddy current testing are discussed, including a plan to conduct a round robin series of tests in which up to eight independent, commercial inspection teams would all inspect the same set of selected tubes in the steam generator.

495 **(PB—85-227502/XAB) Environmental radioactivity at the TMI (Three Mile Island), venting phase.** Bretthauer, E.; Grossman, F.; Efurd, W.; Douglas, G.; Smith, A. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Jun 1985. 15p. (EPA/600/4—85/042). NTIS, PC A02/MF A01.

From June 28 through July 12, 1980, approximately 44,000 curies of krypton-85 were discharged into the environment from the reactor building housing the crippled nuclear reactor at Three Mile Island (TMI). The U.S. Environmental Protection Agency (EPA) operated monitoring networks for krypton 85 (5 stations) and airborne particulates (19 stations). These fixed station networks were supplemented, for the duration of the venting, by two mobile units which sampled within the discharge plume. Calculations of the maximum exposure, based upon measured concentrations of krypton-85, indicated the maximum dose equivalent to the skin to be 0.86 mrem and to the whole body to be 0.0071 mrem. Because the calculated doses derived largely from a few relatively high concentrations of krypton 85, the reported values are well within + or - 10 percent at the 95 percent confidence level.

496 **(CE-Trans—8050) In-service inspection of the steam generator tubes of PWR power stations.** Hervas Garcia, J. Translated from *Nuclear Espana ;* 2: No. 10, 22-30(May 1983). 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901994.

If one analyzes the problem from the point of view of the safety of the power stations, one might ask what are the bases on which one can guarantee that the integrity of the steam generator tubes will be maintained under all operating or postulated accident conditions. These bases are associated with the following concepts: the maximum permissible leak; the preventive requirements for plugging steam generator tubes; and in-service inspections. Although the objective of this paper is to analyze in-service inspection, a few brief comments are made on the other two related con-

cepts: maximum permissible leak and requirements for the plugging of steam generator tubes.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 717, 718, 721, 722

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 147, 540, 541, 674, 675, 676, 692, 693, 694, 697, 698

497 **(EPRI-NP—4222-Vol.1) Compilation of corrosion data on CAN-DECON. Volume 1. General, galvanic, crevice, and pitting corrosion data from CANDU and BWR tests. Final report.** Michalko, J.P.; Bonnici, P.J.; Smee, J.L. (London Nuclear Ltd., Niagara Falls, Ontario (Canada)). Oct 1985. 123p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920019.

Nuclear power station ALARA radiation exposure criteria require, in many cases, decontamination of specific equipment or systems before maintenance, inspection, or work in an adjacent high radiation area. Chemical decontamination, which can be performed away from the high radiation fields, can often best satisfy these ALARA exposure criteria. CAN-DECON, a dilute chemical decontamination process was developed to meet the needs of the Canadian CANDU reactors. It was found to be effective in dissolving BWR oxide films that contain the entrapped radioactive species contributing to high radiation fields. During the development phase of the process and during subsequent field application, CAN-DECON has undergone extensive testing to determine the extent of oxide film dissolution and the degree of corrosion of materials used in construction of reactor components. This has been accomplished on many of the various materials of construction found in the components of the systems decontaminated. Materials tested include carbon steels with range of carbon content 0.1 to 0.4 wt %, 300 series, 400 series, and specialty stainless steels, low alloy steels, and gasket and seal materials. CAN-DECON caused little or no significant corrosion or deterioration on any of the materials tested when applied under conditions appropriate to that class of material. 2 figs., 63 tabs.

498 (INIS-mf—9910-Vol.1, pp 51-76) **Suitability of density and refractive index instruments to the on-line measurement of heavy water concentrations.** Lynch, G.F.; Faught, R.T. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1; AECL—8103).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The requirements for heavy water analyses in Canadian power reactors have been compared to the capabilities of commercially available density and refractive index monitors. It has been concluded that although these instruments do not have sufficient sensitivity for leak detection or process control applications at the extremes of the concentration range, they could be considered for less demanding applications in the intermediate range (1-95 wt percent D_2O). The Agar (Model FD800) vibrational densitometer was considered to be the most suitable of the 39 different instruments that were reviewed and laboratory tests have confirmed that its performance matches that predicted from the manufacturer's specifications.

499 (INIS-mf—9910-Vol.1, pp 108-128) **Dew point response of the annulus gas system of Bruce NGS A. Derivation of a model.** Kenchington, J.; Ellis, P.J.; Meranda, D. (Ontario Hydro, Toronto (Canada)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The dew point response of the Annulus Gas System in Bruce A, Units 1 and 2 has been modelled in order to alert the operator of the presence of heavy water and to estimate the leak rate into the annulus. The computer model can be easily adapted to determine the Annulus Gas System dew point response in any station. It models the complex arrangement of the system and the transportation of moisture through the annuli by a combination of plug flow and mixing of CO_2 and D_2O vapor. It predicts the response of the dew point monitor for a range of specified leak rates and positions of a leaking channel in a string of channels. This model has been used to calculate the variation of dew point and rate of change of dew point with respect to time (t). It shows that there is a maximum in the rate of dew point change (dT/dt) with respect to the corresponding dew point (T). This maximum is unique for a given leak rate and channel position. It is independent of the starting time for the leak. The computer programme has been verified by an analytical solution for the model.

500 (INIS-mf—9910-Vol.1, pp 14-25) **Codes, standards and jurisdictional agreements ensure pressure boundary integrity in Ontario Hydro's reactors.** Stevens-Guille, P.D.; Barnes, R.W.; Perlock, J.W. (Ontario Hydro, Toronto (Canada)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Pressure boundary integrity in Ontario Hydro reactors is enhanced by several factors: Ontario Hydro, as owner, is responsible and involved in all phases of a reactor life-cycle, from design to operation; reactor pressure retaining components (PRC's) are relatively small and thin-walled, employing existing manufacturing technology; the utility/industry/jurisdictional structure is relatively simple and provides communication and co-operation between parties. Over the past decade, experience in design, manufacture, installation and operation has been gathered together in the form of industry standards. In this paper we discuss their application to PRC's.

501 (INIS-mf—9910-Vol.2, pp 38-61) **Materials and processes for CANDU fuel fabrication.** Hoare, M.R. (Westinghouse Canada Inc., Port Hope, Ontario). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

CANDU fuel fabrication comprises the preparation of high density naturally enriched UO_2 pellets, hermetic encapsulation of the pellets in zirconium alloy tubes and final assembly of the subassemblies in a suitable thermal-hydraulic array. The various processes used in the fabrication of the fuel are described with emphasis on the properties of the raw materials that are important for successful manufacture and end use. Specifically this includes consideration of the importance of controlling the physical properties of both the ceramic grade UO_2 powder used for pellet fabrication and of the thin wall Zircaloy-4 alloy tubing used for fuel element manufacture.

502 (INIS-mf—9910-Vol.2, pp 79-84) **Reloading strategy for the Gentilly-2 reactor.** Ngo-Trong, C. (Hydro-Quebec, Montreal (Canada)). 1983. (In French). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The refuelling of a CANDU type reactor such as Gentilly-2 must normally meet the following objectives: maintain criticality, to establish an exterior loop for reactor control and to minimize the cost of operation. This paper briefly describes the method used for the refuelling of Gentilly-2 in order to meet the above objectives.

503 (INIS-mf—9910-Vol.2, pp 1-12) **Decontamination of the Douglas Point reactor, May 1983.** Lesurf, J.E. (London Nuclear Ltd., Niagara Falls, Ontario (Canada)); Stepaniak, R. (Ontario Hydro, Tiverton (Canada). Douglas Point Generating Station); Broad, L.G.; Barber, W.G. (Atomic Energy of Canada Ltd, Tiverton, Ontario (Canada). Douglas Point Generating Station). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The Douglas Point reactor primary heat transport system including the fuel, was successfully decontaminated by the CAN-DECON process in 1975. A second decontamination, also using the CAN-DECON process, was successfully performed in May 1983. This paper outlines the need for the decontamination, the process used, the results obtained, and the benefits to the station maintenance and operation.

504 (INIS-mf—9910-Vol.2, pp 62-75) **Large scale replacement of fuel channels in the Pickering CANDU reactor using a man-in-the-loop remote control system.** Stratton, D. (Spar Aerospace Ltd., Toronto, Ontario (Canada)). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Spar Aerospace Limited of Toronto is presently under contract to Ontario Hydro to design a Remote Manipulation and Control System to be used during the large scale replacement of the fuel channels in the Pickering A Nuclear Generating Station. The system is designed to support the replacement of all 390 fuel channels in each of the four reactors at the Pickering A station in a safe manner that minimizes worker radiation exposure and unit outage time.

505 (NUREG/CR—4272) **Response tree evaluation: experimental assessment of an expert system for nuclear reactor operators.** Nelson, W.R.; Blackman, H.S. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1985. Contract AC07-76ID01570. 66p. (EGG—2397). NTIS, PC A04/MF A01 - GPO. File Number TI86001565.

The United States Nuclear Regulatory Commission (USNRC) sponsored a project performed by EG and G Idaho, Inc., at the Idaho National Engineering Laboratory (INEL) to evaluate different display concepts for use in nuclear reactor control rooms. Included in this project was the evaluation of the response tree computer-based decision aid and its associated displays. The response tree evaluation task was deisgned to (1) assess the merit of the response tree decision aid and (2) develop a technical basis for recommendations, guidelines, and criteria for the design and evaluation of computerized decision aids for use in reactor control rooms. Two major experiments have been conducted to evaluate the response tree system. This report emphasizes the conduct and results of the second experiment. An enhanced version of the response tree system, known as the automated response tree system, was used in a controlled experiment using trained reactor operators as test subjects. This report discusses the automated response tree system, the design of the evaluation experiment, and the quantitative results of the experiment. The results of the experiment are compared to the results of the previous experiment to provide an integrated perspective of the response tree evaluation project. In addition, a subjective assessment of the results addresses the implications for the use of advanced, "intelligent" decision aids in the reactor control room.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 573, 580, 596, 668, 704, 714, 723, 724, 726, 748, 1183

506 **(ANL—85-28) Studies of axial-leakage simulations for homogeneous and heterogeneous EBR-II core configurations.** Grimm, K.N.; Meneghetti, D. (Argonne National Lab., IL (USA)). Aug 1985. Contract W-31-109-ENG-38. 71p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001305.

When calculations of flux are done in less than three dimensions, leakage-absorption cross sections are normally used to model leakages (flows) in the dimensions for which the flux is not calculated. Since the neutron flux is axially dependent, the leakages, and hence the leakage-absorption cross sections, are also axially dependent. Therefore, to obtain axial flux profiles (or reaction rates) for individual subassemblies, an XY-geometry calculation delineating each subassembly has to be done at several axial heights with space- and energy-dependent leakage-absorption cross sections that are appropriate for each height. This report discusses homogeneous and heterogeneous XY-geometry calculations at various axial locations and using several differing assumptions for the calculation of the leakage-absorption cross section. The positive (outward) leakage-absorption cross sections are modeled as actual leakage absorptions, but the negative (inward) leakage-absorption cross sections are modeled as either negative leakage absorptions (+-B^2 method) or positive downscatter cross sections [the Σ/sub s/(1 $\rightarrow$ g) method]. 3 refs., 52 figs., 10 tabs.

507 **(ANL—85-56) Leakage flow-induced vibration of an eccentric tube-in-tube slip joint.** Mulcahy, T.M. (Argonne National Lab., IL (USA)). Aug 1985. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001460.

Eccentricity of a specific slip-joint design separating two cantilevered, telescoping tubes did not create any self-excited lateral vibrations that had not been observed previously for a concentric slip joint. In fact, the eccentricity made instabilities less likely to occur, but only marginally. Most important, design rules previously established to avoid instabilities for the concentric slip joint remain valid for the eccentric slip joint. 6 refs., 9 figs., 2 tabs.

508 **(CEA-CONF—7487) Eddy-current guidance of the automatic inspection machine for the main vessel of the superphenix reactor.** David, B.; Pigeon, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1985. 4p. (CONF-850112—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752825.

From 7. international conference on nondestructive evaluation in the nuclear industry; Grenoble, France (29 Jan 1985).

The weld detector device is an eddy-current measurement system consisting of four dual sensors (absolute + differential types), and a control cabinet with eight analog channels. The system delivers all the signals required for computing the correct track of the MIR machine along the welds, irrespective of bend, temperature, width and type of the seam, junctions of seams.

509 **(CEA-CONF—7494) In service inspection of superphenix 1 vessels: MIR.** Asty, M.; Viard, J.; Lerat, B.; Saglio, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1985. 4p. (CONF-850112—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752822.

From 7. international conference on nondestructive evaluation in the nuclear industry; Grenoble, France (29 Jan 1985).

Presentation is given of the in-service inspection device, MIR, which has been specially developed for the visual and ultrasonic examination of Super Phenix 1 vessels (surface and internal defects). The inspections take place during fuel handling operations. The inspection device is a robot with a four-wheel drive vehicle whose guidance along the welds is achieved by eddy-current devices; visual examination is performed by a television camera and by ultrasonic probes which are specially resistent to high temperatures.

510 **(CEA-CONF—7633) Thermal crackling: study of the mechanical effects of quick temperature fluctuations on metallic surfaces.** Pradel, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). May 1984. 8p. (In French). (CONF-8405353—1; DRNR-P—291). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752900.

From Symposium on thermal stress; Paris, Franc (2 May 1984).

After a brief overview of the thermohydraulical conditions of liquid sodium leading to important temperature fluctuations near the metallic surfaces, the author examines the transfer modes of these fluctuations in the structure thickness and the long term mechanical effects. Dimensioning models based on thermal and metallurgical properties are under study for structures subject to such sodium loads.

511 **(CEA-CONF—7634) Failure diagnostic expert systems for fast reactors.** Himbaut, S.; Le Guillou, G.; Quinton, J.C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). May 1984. 18p. (In French). (CONF-8405354—1; DRNR-P—292). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752901.

From Colloquium on expert systems and applications; Avignon, France (2 May 1984).

The aim of SYSTEME EXPERT is to permit diagnostics of one (or more) casual failure of the "ultimate resort cooling" (RUR) (including monitoring or control sensor failures) from data given (or not) by the various sensors or by the classical alarm systems. It comprises the following modules: an interface (in French) for information acquisition with possible suppression of the rules, a demonstrator of SL-resolution type, a data incoherence test an inverse interface for listing the collections.

512 **(CEA-CONF—7635) Tritium and hydrogen behaviour at Phenix power plant. Application to development and validation of KUMAR type models.** Tibi, A.; Misraki, J.; Feron, D. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 23p. (In French). (CONF-840411—40; DRNR-P—274). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752916.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Experimentations at Phenix reactor confirmed the fitness of the KUMAR model for predicting the behaviour of hydrogen and tritium, and thus, prevision of the tritium distribution at Super Phenix reactor. Calculation of the tritium content of a regenerated secondary cold trap, behaviour of hydrogen during power operation, the primary cold trap being deliberately outage, and estimation of the tritium and hydrogen sources and permeation transfer ratios are presented.

513 **(CEA-CONF—7636) Sensor for thickness measurement of a liquid metal film.** Blanc, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 7p. (In French). (CONF-840411—39; DRNR-P—275). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752915.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Description, calibration and measuring methods are described for a sensor for the measuring thin liquid metal depths in a temperature range of 0-500°C and for shift frequencies from 0 to 100 Hz. These sensors are based on the principle of induction-coil impedance variation, as a function of the thickness of an electrical conductor matter placed in the coil magnetic field.

514 **(CEA-CONF—7638) Hydrothermic behaviour of intermediate heat exchangers in a pool-type fast breeder reactor.** Marcellin, C.; Guidez, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 5p. (CONF-840411—37; DRNR-P—277). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752913.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Flow distribution (primary and secondary sodium flows) and heat transfer calculations (tube side convection, cross and parallel primary flow) are described. Analysis and design of heat exchanger bundles configuration in relation with the experimental results and computation calculations are presented. Application of computations to the Phenix intermediate heat exchanger is included.

515 **(CEA-CONF—7639) Radiation heat transfer through the gas of a sodium cooled fast breeder reactor.** Pradel, P.; Frachet, S.; Petit, D. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 5p. (CONF-840411—36; DRNR-P—278). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752912.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Analysis based on results from the COCA test campaign and Germinal mockup of Super Phenix upper shuttings, of the heat transfers and radiation attenuation due to sodium aerosols between the free surface of sodium and the upper shuttings is presented.

516 **(CEA-CONF—7640) Open azimuthal thermosiphons in annular spaces. Comparisons of experimental and numerical results.** Baldassari, J.; Durin; Severi; Pradel, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 6p. (CONF-840411—35; DRNR-P—279). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752911.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

In narrow annular spaces (50-70 mm) existing between the components and the slab in Liquid Metal Fast Breeder Reactor open azimuthal thermosiphon flows occur, bringing azimuthal temperature differences sometimes very high, thus leading to important mechanical stresses on the reactor components. The aim of this study is to develop a computer code (using a finite difference method) which calculates velocity and gas temperature fields in the annular spaces surrounding components and to compare the numerical results with results obtained on an experimental model, a penetration of a mockup representing the upper shuttings of a fast reactor.

517 **(CEA-CONF—7641) Sodium-water reactions experiments in a mockup of a Super Phenix vapor generator.** Biscarel, J.; Ferreti, G.; Pacifico, P.; Pasquale, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 17p. (In French). (CONF-840411—32; DRNR-P—280). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752908.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Two types of experiments were conducted: - experiments with large water leakages in order to develop a computer code for the sodium-water reactions in large dimension tanks, - experiments with medium size water leakages in order to estimate the time of damage appearance (secondary failures) and study the resistance of alloy-800 to sodium water reactions.

518 **(CEA-CONF—7642) Heat transfer study for vertical straight-tube steam generators heated by liquid metal.** Valette, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 8p. (CONF-840411—33; DRNR-P—281). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752909.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

A single-tube mockup of a vertical straight-tube steam generator heated by sodium-potassium alloy NaK was submitted to thermal and hydraulic testing in conditions representative of fast breeder reactor operation. The mockup consisted of a 10mm I.D. ferritic steel heat exchange tube centered inside a cylindrical stainless steel

shell. The complete assembly was 20.9 meters long. Water flowed upward inside the exchange tube, and NaK flowed downward in the annular gap between the tube and the shell. The steam outlet pressure ranged from 90 to 195 bars, while the liquid metal temperature at the mockup inlet was between 480 and 580°C. The water flowrate in the tube ranged from 153 to 2460 $kg.m^{-2}.s^{-1}$. During the tests the fluid inlet and outlet temperatures, flowrate and pressures were measured, as was the NaK temperature profile over the full length of the device. The test results were subsequently compared with heat exchange and pressure drop values calculated using the standard formulas for straight-tube heat exchangers. The heat exchange coefficients predicted by these correlations in the boiling zone were found to be largely overestimated, while the calculated pressure drop values proved satisfactory. A set of modified correlations is proposed to account for the observed phenomena, and for use in designing commercial units, provided the sodium flow in the tube bundle is adequately distributed.

519 **(CEA-CONF—7643) Vibration sensors.** Poinsot, S. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 13p. (In French). (CONF-840411—34; DRNR-P—282). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752910.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

These sensors, which aim is the surveillance of the fast breeder reactor internal structure, were designed considering the following requirements: - long term utilization under low frequencies conditions (1 to 50 Hz) and detection of accelerations lower than 0,01 g, - operation with a temperature up to 600°C and receiving important neutron and gamma flux. Monoaxial sensors with a liquid vibrating mass (sodium) were thus developed, based on the electromagnetic flow meter principles (Faraday effect).

520 **(CEA-CONF—7644) Sodium tests on an integrated purification prototype for a sodium-cooled fast breeder reactor.** Abramson, R.; Vallee, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 8p. (CONF-840411—29; DRNR-P—283). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752905.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

This paper describes sodium tests performed on the integrated primary sodium purification prototype of the Creys Malville Super Phenix 1 fast breeder reactor. These tests comprised: - hydrostatic test, - thermal tests, - handling tests. They enabled a number of new technological arrangements to be qualified and provided the necessary information for the design and construction of the Super Phenix 1 purification units.

521 **(CEA-CONF—7645) Hydrogen diffusion and permeation in sodium.** Trouve, J.; Laplanche, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 7p. (CONF-840411—30; DRNR-P—284). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752906.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Hydrogen is a common impurity found in the sodium used as the coolant medium in fast breeder reactors or in experimental loops. It is produced by a sodium-water reaction (cover gas, steam generator) or results from hydrogen diffusion throught the metal walls of the steam generator. The steam generator hydrogen content is continuously monitored by a hydrogen meter that measures the H_2 gas flow across a nickel membrane. The value of this information to the reactor operator as an indication of steam generator operation is determined to a certain extent by the accuracy with which the hydrogen diffusion coefficient in sodium is known. This coefficient is also required by the component designer for use in computer codes. The study discussed in this paper examined the behavior of thin nickel sheeting used to manufacture hydrogen meters, and the hydrogen diffusion coefficient for sodium was estimated as a function of temperature.

522 **(CEA-CONF—7646) Study of sodium oxide crystallization mechanisms and kinetics in cold traps.** Latge, C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 7p. (CONF-840411—31; DRNR-P—285). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752907.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

After showing up the present lack of data on crystallization mechanisms and kinetics, a number of tests were conducted on a sodium test loop equipped with two experimental cold traps. The effects of several geometric and thermohydraulic parameters on purification efficiency were also studied. The test results were used to develop a simulation model. An optimization code based on the model can be used to determine the nucleation and growth kinetics.

523 **(CEA-CONF—7648) Incipient cavitation and cavitating erosion in sodium flow.** Courbiere, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 8p. (CONF-840411—27; DRNR-P—287). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752903.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

The high sodium flow rates required by the reactor power rating imply the use of sodium loop and pump designs in which a cavitation hazard exists. This paper discusses CEA test results on incipient cavitation and on cavitation erosion in sodium based on sodium-water similitude criteria, and entrained gas effects on the incipient cavitation threshold.

524 **(CEA-CONF—7649) Stress corrosion of austenitic steels in a sodium-soda medium.** Ardelier, J.; Raffailhac, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 6p. (CONF-840411—18; DRNR-P—288). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752904.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Stress corrosion was studied on the materials (alloy 800, 316 and 316 L, stainless steels, etc.) used for fast breeder reactor secondary loops containing soda-contaminated sodium at 400°C to 550°C. Under particularly severe conditions (exposure for 1000 hours at up to 10% soda content) an intergranular stress corrosion cracking process was observed above a temperature-dependent stress threshold.

525 **(CEA-CONF—7650) Utilization of large electromagnetic pumps in the fast breeder reactors.** Deverge, C.; Lefrere, J.P.; Peturaud, P.; Sauvage, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 26p. (In French). (CONF-840411—24; DRNR-P—289). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752898.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

After an overview concerning the induction annular electromagnetic pumps and the dimensioning methods usually utilized, development of these components for a fast breeder integrated reactor is considered: - utilization of cooled EMP in the intermediate circuit, - utilization of immersed pumps, coupled with the intermediate exchanger, for the primary pumping; dimensioning, energetic aspects, and effects on the power plant geometrical configurations.

526 **(CEA-CONF—7651) High temperature fission chambers. Fast breeder reactor research and development program.** Berlin, C.; Perrigueur, J.C.; Duchene, J.; Tixier, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Apr 1984. 34p. (In French). (CONF-840411—25; DRNR-P—290). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752899.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Development of a high temperature fission chamber and experimentations of measuring channels (detectors and electronic devices) in similar conditions as those of power plants: development of measuring channels (impulses and current) of the Super Phenix neutronic measures auxiliary system, development of a measuring channel with impulses for the surveillance system of the clad failures, based on integrated detectors, and development of a fission chamber for experimentations in similar conditions as in Superphenix.

527 **(CEA-CONF—7784) Standards for the fission yields measurements.** Blachot, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Nov 1984. 21p. (CONF-8411200—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752917.

From 3. international conference of liquid metal engineering and technology in energy production; Geel, Belgium (12 Nov 1984).

Two main methods are now used for the determination of fission yields. The gamma spectrometry, without or with radiochemical separations and the mass spectrometry using isotopic dilution. Fission yields are needed in burn up determination, dosimetry, safeguards and also in basic science (study of the fission mechanism). The ^{235}U thermal neutron induced fission yields have been extensively studied. Complete and up to date evaluations for this system are available. The development of the most important of these fission yields, as standards, could be a good solution. They are easily measured and they allow the fulfilment of all the applications. A short review of all data available will be given. Only the gamma spectrometry method will be described. Some recommended decay data will be discussed. The experimental method will be also shortly described.

528 **(HEDL—7554) Breeder Spent Fuel Handling Program multipurpose cask design basis document.** Duckett, A.J.; Sorenson, K.B. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1985. Contract AC06-76FF02170. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001556.

The Breeder Spent Fuel Handling (BSFH) Program multipurpose cask Design Basis Document defines the performance requirements essential to the development of a legal weight truck cask to transport FFTF spent fuel from reactor to a reprocessing facility and the resultant High Level Waste (HLW) to a repository. 1 ref.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

529 **(AD—460642/2/XAB) Terrestrial direct-conversion nuclear power plant conceptual design. Rept. for 15 June-7 December 1064.** Zindler, G.F. (Martin Co., Middle River, MD (USA). Nuclear Div.). Mar 1965. 252p. (MND—3193). NTIS, PC A12/MF A01.

This study presents a detailed investigation and parametric analysis for the conceptual design of a terrestrial, direct-conversion, nuclear power plant to satisfy power requirements for deployed or deployable forces. The power plant conceptually presented by this study is capable of producing 100 kW net electricity as 480-volt, 60-cps, 3-phase power. The plant is designed to provide for five years of continuous operation at full power without refueling. The conceptual power plant consists of two modules, one approximately five feet in diameter and 19 feet long, weighing approximately 16,000 pounds, and the other 3 by 3 by 5 feet, weighing approximately 2,000 pounds. The plant modules can be transported by large cargo aircraft or any conventional land or sea vehicle. Field erection can be accomplished by standard military service equipment. The power plant concept embodies an inherent, self-controlling feature that would permit the plant to operate for long periods of time without attendance. The power generation rate is automatically adjusted to meet the electrical load requirements without the need for mechanical or electrical control systems.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 702, 703

530 **(CEA-CONF—7844) Safety organization.** Lutz, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jun 1984. 27p. (In French). (CONF-8406287—1; DAS—120). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752887.

From Meeting of the CEE working group on hot laboratories and remote handling; Harwell, UK (13 Jun 1984).

After a rapid definition of a nuclear basis installation, the national organization of nuclear safety in France is presented, as also the main organizations concerned and their functions. This report shows how the licensing procedure leading to the construction and exploitation of such installations is applied in the case of nuclear laboratories of research and development: examinations of nuclear safety problems are carried out at different levels: - centralized to define the frame out of which the installation has not to operate, - decentralized to follow in a more detailed manner its evolution.

531 **(DOE/NBM—5018246) Regulatory reform data support evaluation of regulatory process. Draft.** (United Engineers and Constructors, Philadelphia, PA (USA). Advanced Engineering Dept.). Oct 1982. Contract W-31-109-ENG-38. 283p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85018246.

This report provides data support on issues associated with the President's regulatory reform program. A previous report prepared by United Engineers and Constructors Inc. (UE and C) focused on the key issues to be resolved to improve the regulatory climate and streamline procedures. The report recognized the paralyzing effect of attempting to approach zero risk and to obtain legal proof of perfection. This approach leads to goals which are fundamentally unattainable. The objectives of reform are related to the reduction of overall schedules and costs. Consistent with these objectives is the goal to provide a more practical approach to engineering and construction consistent with realistic safety goals. UE and C prepared a series of follow-on case studies reports directed to determining specific examples of regulatory requirements and their industrial interpretations. The program had as a goal to determine why the commodities and field craft labor showed a constant increase between plants of different vintage design. This report is directed to providing support data for use in the evaluation of the regulatory process. The three tasks covered by the report include Low Probability Accidents, Backfit Requirements, and Examples of Regulatory Impact.

532 **(NUREG—0436-Rev.1-Suppl.1) Plan for reevaluation of NRC policy on decommissioning of nuclear facilities. Revision 1, Supplement 1.** Calkins, G.D. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Standards). Aug 1980. 30p. NTIS, PC A03/MF A01 - GPO. File Number TI86900072.

This report supplements and updates the information presented in NUREG-0436, Rev. 1, of the same title and dated December 1978. Supplement 1 defines new terminology for the decommissioning alternatives. It updates the status and schedules for developing the information base, the draft generic environmental impact statement, and the rulemaking. In addition, schedules for regulatory guides to support the rules are presented.

533 **(NUREG—0540-Vol.7-No.8) Title list of documents made publicly available. Volume 7, No. 8.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). Sep 1985. 625p. NTIS, PC A99/MF A01 - GPO. File Number TI86900155.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of radioactive materials and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index,and a Report Number Index.

534 (NUREG—0748-Vol.5-No.7) **Operating reactors licensing actions summary. Volume 5, No. 7.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Sep 1985. 361p. NTIS, PC A16/MF A01 - GPO. File Number TI86900086.

The Operating Reactors Licensing Actions Summary is designed to provide the management of the Nuclear Regulatory Commission (NRC) with an overview of licensing actions dealing with operating power and nonpower reactors. These reports utilize data collected from the Division of Licensing in the Office of Nuclear Reactor Regulation and are prepared by the Office of Resource Management.

535 (NUREG—0750-Vol.22-No.1) **Nuclear Regulatory Commission Issuances. Volume 22, No. 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Jul 1985. 184p. NTIS, PC A09/MF A01 - GPO. File Number TI85902224.

This report includes the issuances received during July 1985 from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

2108 Economics

REFER ALSO TO CITATION(S) 167, 695, 696, 771

536 (INIS-mf—9910-Vol.1, pp 1-15) **Computer-based training techniques for the nuclear industry.** Lucas, S.J. (CAE Electronics Ltd., Montreal, Quebec (Canada)); MacBeth, M.J. (Ontario Hydro, Toronto (Canada)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The use of full-scope simulators in the training of operators for nuclear generating stations is now fairly well established. The use of computer-based systems in the more basic aspects of training is an area of increasing development with the advent of high-quality graphic displays and touch-sensitive screens. The Computer-Managed Training (CMT) system is an example of such a system. The CMT system offers an alternative to more traditional methods of training in basic principles, procedures and theory. The trainee learns through self-paced demonstrations and instructions, with evaluations providing directions toward improving weak areas. The first part of this paper discusses the general features offered by computer-based training systems. The second part of the paper describes some specific applications which are in use at Ontario Hydro.

537 (INIS-mf—9910-Vol.2, pp 13-25) **Leading technologies for nuclear maintenance.** Boucharel, J.L. (Compagnie Francaise de Maintenance Industrielle, 75 - Paris (France)). 1983. (In French). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The author mentions three developments of the CFMI group which have found particularly remarkable applications in the field of nuclear maintenance: the utilization of a mobile decontamination unit for the treatment of a closed circuit of machinery, electronic fittings, optical fittings, etc.; the application of electropolishing to the cleaning and decontamination of important surfaces or bulky equipment; the development of computer automated inspection of steam generators.

538 (NUREG—0020-Vol.9-No.6) **Licensed operating reactors. Status summary report data as of May 31, 1985. Vol. 9, No. 6.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Jul 1985. 441p. NTIS, PC A19/MF A01 - GPO. File Number TI85902010.

This report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Resource Management from the Headquarters staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, IE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US.

539 (NUREG/CR—2353-Vol.1) **Specification and verification of nuclear power plant training simulator response characteristics. Part 1. Summary of current practices for nuclear and non-nuclear simulators. Volume 1.** Belsterling, C.A.; Pandey, S.; Prasklevicz, J.C.; Kozinsky, E.J.; Felkins, L.; Haas, P.M. (Oak Ridge National Lab., TN (USA)). Dec 1981. Contract AC05-84OR21400. 184p. (ORNL/TM—7985-Pt.1). NTIS, PC A09/MF A01 - GPO. File Number TI86000934.

This report reviews the methods and practices of the nuclear industry for specifying and verifying the performance characteristics of simulators used to train nuclear power plant operators. It also reviews the training simulator methods and practices of selected non-nuclear industries (in particular, the civilian and military aircraft industries) and compares them with those of the nuclear industry. In addition, it identifies non-nuclear methods that might be profitably adopted by the nuclear industry and perhaps included in a simulator standard endorsed by the Nuclear Regulatory Commission. Final conclusions and recommendations are discussed in a companion report (NUREG/CR-2353, Vol. 2; ORNL/TM-7986).

2109 Process Heat Reactors

540 (INIS-mf—9910-Vol.1, pp 77-107) **Possible use of a CANDU reactor as a dual-temperature heat source.** Giusti, D.; Andrews, D.G. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The increasing interest in synthetic hydrocarbon production in North America, together with preliminary plans now being laid in Canada for a future highly-developed hydrogen economy, call for high-grade, long-term, non-fossil energy sources which can provide adequate quantities of process heat at the exajoule level. Whereas the high-temperature gas-cooled reactor has been considered for a number of years as a suitable and reliable process heat source, the pressurized-water family of reactors, including the CANDU heavy water reactor, have not so far been able to achieve the required temperatures. In the present paper, a new fuel element is proposed which is intended to provide the appropriate proportions of high-quality process heat. It is designed for use in regular channels of CANDU reactors such as those in operation at Bruce NGS.

541 (INIS-mf—9910-Vol.2, pp 50-72) **Use of nuclear process heat for methane and hydrogen production via in-situ coal gasification.** Templar, R.; Andrews, D.G. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Coal gasification plants and processes have been in existence for many years, using fossil fuel as the source of energy input. However, there appear to be no significant installations carrying out in-situ coal gasification and using high-temperature, high pressure, process heat (e.g., as steam) from a high-temperature nuclear reactor. In the present paper, historical and theoretical aspects of gasification are outlined and a concept is put forward for a full-scale commercial in-situ coal gasification plant using process steam from a high-temperature gas-cooled nuclear reactor, and producing two streams, one being methane for transport use and industrial feedstock, and the other being hydrogen for a future hydrogen economy. The possibility of a CANDU reactor meeting the thermal requirements is discussed.

542 (INIS-mf—9910-Vol.2, pp 31-54) **Reactivity calculations for the 2 MWth SLOWPOKE-3 heating reactor.** Irish, J.D. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Atomic Energy of Canada Limited is presently carrying out a design study for a 2 MWth prototype of a SLOWPOKE-3 heating reactor. Reactors of this type have a potential application for district-heating in remote communities and for heating large buildings. The core consists of 193 CANDU BRUCE-sized fuel elements with the uranium enriched to 5 wt. percent sup(235)U. The coolant-moderator is Hsub(2)O at atmospheric pressure. The general reactor design and safety features are outlined.

22 NUCLEAR REACTOR TECHNOLOGY

543 **(DOE/TIC—8200-R48) Nuclear reactors built, being built, or planned in the United States.** (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Aug 1984. 51p. (PB—84-903001). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84010075.

This booklet contains unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of Apr. 30, 1984, which are capable of sustaining a nuclear chain reaction. Information is presented in five parts, each of which is categorized by primary function or purpose: civilian, military, production, export, and critical assembly facilities.

544 **(NE-F—2-10-8-85) Quality assurance program requirements (Supplement to ANSI/ASME NQA-1).** Cooper, W.L. Jr. (Oak Ridge National Lab., TN (USA)). 22 Aug 1985. Contract AC05-84OR21400. 24p. Performance Assurance Project Office, ORNL, Box Y, Bldg. 9204-1, Oak Ridge, TN 37831 . File Number TI86000185.

ANSI/ASME NOA-1 is the preferred genetic quality assurance program standard for all new licensed, licensable, and unlicensed nuclear facilities and associated development and data acquistion activites under the cognizance of the Assistant Secretary for Nuclear Energy (NE). This standard, NE F 2-10, has been developed to amplify or modify the requirements of ANSI/ASME NQA-1, and is intended to be used in conjunction with that standard for programs under NE cognizance. Sandard NE F 2-10 incorporates those requirements of RDT F 2-2 that are not covered by ANSI/ASME NQA-1, as well as new or modified requirements, which are considered appropriate and necessary for NE nuclear facilities and associated development and data acquisition activities.

2201 Theory And Calculation

545 **(LA-UR—85-3416) Source-jerk analysis using a semi-explicit inverse kinetic technique.** Spriggs, G.D.; Pederson, R.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 10p. (CONF-8508105—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000803.

From DOE subcritical reactivity measurements workshop; Albuquerque, NM, USA (26 Aug 1985).

A method is proposed for measuring the effective reproduction factor, k, in subcritical systems. The method uses the transient response of a subcritical system to the sudden removal of an extraneous neutron source (i.e., a source jerk). The response is analyzed using an inverse kinetic technique that least-squares fits the exact analytical solution corresponding to a source-jerk transient as derived from the point-reactor model. It has been found that the technique can provide an accurate means of measuring k in systems that are close to critical (i.e., $0.95 < k < 1.0$). As a system becomes more subcritical (i.e., $k << 1.0$) spatial effects can introduce significant biases depending on the source and detector positions. However, methods are available that can correct for these biases and, hence, can allow measuring subcriticality in systems with k as low as 0.5. 12 refs., 3 figs.

546 **(NUREG/CR—1969) Local volume-averaged transport equations for single-phase flow in regions containing fixed, dispersed heat-generating (or absorbing) solids.** Sha, W.T.; Chao, B.T. (Argonne National Lab., IL (USA)). Apr 1981. Contract W-31-109-ENG-38. 133p. (ANL—80-124). NTIS, PC A07/MF A01 - GPO. File Number TI86000893.

Local volume-averaged conservation equations for single-phase flow in regions containing dispersed but fixed heat-generating solids are presented. The concept of volume porosity and surface permeability arises naturally in the formulation. Special forms of these equations in finite-difference formulation with nonuniform, staggered grids are given for the Cartesian and for the cylindrical-coordinate system. These systems of the volume-averaged finite-difference equations do not form a complete set. Additional relationships between the volume-averaged and area-averaged flow variations are needed for closure. These relationships are formally examined, and plausible approximations are proposed.

547 **(ORNL/TM—9642) Applications guide to the RSIC-distributed version of the KENO-V code.** Cramer, S.N. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001373.

A review of the KENO-V multigroup Monte Carlo criticality code available from the Radiation Shielding Information Center (RSIC) at Oak Ridge National Laboratory (ORNL) is presented. All aspects of the code are discussed, including the stand-alone and SCALE system modules and the applicable computer hardware systems. The cross-section requirements are outlined, and the available code package libraries and other necessary data are defined. The supergroup feature for use of the code on small computer systems is explained. The capabilities and limitations of the KENO array geometry description are illustrated. Various aspects of the random-walk and estimation procedures are itemized. Examples of the various calculated values of k/sub eff/ and its statistical uncertainty are shown in standard output listings. Finally, a summary of sample problems and future work is given.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 456, 691, 734, 873, 877, 889, 907

548 **(BMI—1984-058) Comparison of American and German methods in strength calculation for nuclear facilities. 2nd technical report.** Kraegeloh, E.; Trunk, M.; Herter, K.H. (Bundesministerium des Innern, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt). Nov 1984. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752720.

The American ASME-BPVC code is the prominent code in the field of nuclear technology. A comparable German code (KTA-Code) is in preparation. The existing codes (AD, TRD, etc.) do not meet the increased safety requirements. The comparison refers to various loading cases and maximum admissible stresses, (design, normal and off-normal operation, emergencies, accidents) and to the limitation of stresses in specific cases (pressure test). Other loadings (fatique, additional forces, brittle fracture) are also considered.

549 **(BMI—1984-060) Effects of mean stress on the fatigue strength under oscillation stresses with ductile steels. 4th technical report.** Trunk, M. (Bundesministerium des Innern, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt). Nov 1984. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85752722.

The effect of the mean stress is quantified and an assessment is made showing how it is applied in technical codes. With respect to the application to nuclear power plants, the regulations for reactor pressure vessels are reviewed. It is to be checked whether the design was made for nominal stress peaks or for elongation amplitudes at the point of highest load. Considering different failure criteria, note that the effects of a given mean stress are different with respect to yield strength and tensile strength. This is to be considered in the method of approximation for the fatigue strength.

550 **(BNL-NUREG—29268) Piping benchmark problems.** Bezler, P.; Hartzman, M. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). 1981. Contract AC02-76CH00016. 12p. (CONF-810625—2). NTIS, PC A02/MF A01 - GPO. File Number TI86000116.

From ASME PVP conference; Denver, CO, USA (21 Jun 1981).

A set of benchmark problems and solutions have been developed for verifying the adequacy of computer programs used for dynamic analysis and design of nuclear piping systems by the Response Spectrum Method. The problems range from simple to complex configurations which are assumed to experience linear elastic behavior. The dynamic loading is represented by uniform support motion, assumed to be induced by seismic excitation in three spatial directions. The solutions consist of frequencies, participation factors, nodal displacement components and internal force and moment components. Solutions to associated anchor point motion static problems are not included. A summary description of each problem including a description of the input parameters, pertinent output results and the reasons for problem selection are included. The problem set is presently being used by the Mechanical Branch of the Nuclear Regulatory Commission to confirm the adequacy of the computer programs used by applicants for nuclear power plant licenses. 9 refs., 14 figs., 2 tabs.

551 **(CEA-CONF—7489) Application of data processing to eddy current measurements: design, preparation and use of eddy current maps.** David, B.; Pigeon, M.; Birac, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1985. 4p. (CONF-850112—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752824.

From 7. international conference on nondestructive evaluation in the nuclear industry; Grenoble, France (29 Jan 1985).

Mapping provides an eddy-current image of the examined surfaces which is independent from the data acquisition method. Optimization of viewing angle, contrast and perspective plotting contributes to enhancement of image quality. Image interpretation is facilitated by signal pre-processing in the form of filtering, removal of spurious repetitive patterns, or non-linear amplification.

552 **(CEA-CONF—7490) Application of data processing to eddy current measurements: variable geometry and virtual displacement probes.** Pigeon, M.; David, B.; Lamant, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1985. 4p. (CONF-850112—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752823.

From 7. international conference on nondestructive evaluation in the nuclear industry; Grenoble, France (29 Jan 1985).

Simulation of probe track permits matching probe to defects, based on a single initial acquisition. Certain rules must be observed for correct simulation. Examples are given of differential and double-differential simulation; adequate and poor matching of probe to defect are illustrated. Track simulation is of interest in cases where the direction of probe motion is determined by the acquisition process. Enhanced interpretation capabilities are provided by digital filtering of signals.

553 **(CONF-8410275—Vol.2) Proceedings of the 3. Brazilian Congress of Energy. Vol. 2.** (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia; Clube de Engenharia, Rio de Janeiro (Brazil)). 1984. 472p. (In Portuguese). Centro de Informacoes Nucleares, Rio de Janeiro, Brazil.

From 3. Brazilian congress of energy; Rio de Janeiro, Brazil (8 Oct 1984).

Some papers showing specifications for nuclear power plants components done by Nuclebras Engineering S/A (Nuclen) are presented. (E.G.).

554 (CONF-8410275—Vol.2, pp 641-646) **Project of mechanical components for nuclear power plants.** Amaral, J.A.R. do; Farias Brito David, D. de. (NUCLEN, Rio de Janeiro, Brazil). 1984. (In Portuguese). Centro de Informacoes Nucleares, Rio de Janeiro, Brasil. (CONF-8410275—Vol.2).

From 3. Brazilian congress of energy; Rio de Janeiro, Brazil (8 Oct 1984).

The equipment foreseen to be part of a nuclear power plant must show high quality and safety due to the presence of radioactivity. Besides the perfect functioning during the rigid operating conditions, some postulated loadings are foreseen, like earthquake and loss of coolant accidents, which must be also considered in the design of the components. The design and calculation's concept and development, the interactions with the piping and civil designs, as well as their influences in the licensing process with the authorities are described. (Author).

555 (CONF-8410275—Vol.2, pp 647-656) **Project of mechanical system in NUCLEBRAS ENGINEERING S/A (NUCLEN).** Lepecki, W.P.S. (NUCLEN, Rio de Janeiro, Brazil). 1984. (In Portuguese). Centro de Informacoes Nucleares, Rio de Janeiro, Brasil.

From 3. Brazilian congress of energy; Rio de Janeiro, Brazil (8 Oct 1984).

A general description of the working methodology and of the technology transfer in the area of the mechanical systems design of Nuclebras Engineering S/A (Nuclen). (E.G.).

556 (CONF-8410275—Vol.2, pp 667-676) **Importance of the stress analysis in the project of a nuclear power plant.** Carvalho, J.C.F. de. (NUCLEN, Rio de Janeiro, Brazil). 1984. (In Portuguese). Centro de Informacoes Nucleares, Rio de Janeiro, Brasil.

From 3. Brazilian congress of energy; Rio de Janeiro, Brazil (8 Oct 1984).

The importance of the stress analysis in the project of a nuclear power plant is shown. The typical techniques that are used in Nuclen for design and calculation of the piping of nuclear power plants are described, showing at the end the necessary documentation for erection and the volume of the calculation work that has to be done. (Author).

557 **(EPRI-NP—4264-Vol.2) Failures related to surveillance testing of standby equipment. Volume 2. Diesel generators. Final report.** Mollerus, F.J.; Allen, R.D. (Mollerus Engineering Corp., Los Gatos, CA (USA)). Sep 1985. 69p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920894.

A study is made of failures of emergency diesel generators at nuclear power plants. The objective is to identify failures in which surveillance testing (in particular, fast starts, fast loading and the large number of starts) has been a contributing factor. The failures

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are described, corrective actions identified, and information is presented on diesel vendors' recommendations for testing and maintenance. An example of a successful effort to improve diesel generator reliability is detailed. A description of reference documents on nuclear plant stand-by diesel generators is also included. 8 refs., 2 figs., 7 tabs.

558 **(FRA—142-1) Qualification of electric equipments for nuclear power plants.** Chauvin, G.; Raimondo, E. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Mar 1983. 40p. (In French). (CONF-8303209—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752870.

From SFEN meeting on qualification of electric nuclear equipments; Cadarache, France (9 Mar 1983).

Description of the testing equipment, testing methods and standards of the resistance to seisms of electrical equipments (switches, pump motors, electrovalves, etc.) for electronuclear power plants in France. Presentation of the French design and construction rules for electrical devices in the domestic and export nuclear market (resistance to thermodynamical and chemical stresses, to seisms, etc.).

559 **(FRA—142-3) Recent development for improving of PWR flexibility to load follow and frequency control operation.** Dubourg, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Aug 1983. 9p. (CONF-830805—103). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752872.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

In order to adjust the PWR electricity generation to the consumption network, new operating conditions were established. Those new conditions generate additional mechanical and thermal sollicitations due to the frequent motion of control rod banks, consisting of mechanical fatigue cycling and wear at the level of control rode drive mechanisms, control rods and guide tubes, wear and thermal fatigue cycling at the level of fuel assemblies. This paper presents the various aspects of this program including identification of the most critical areas of components, basic research in laboratories for resolving wear problems in PWR environment, improvement of local hydraulics for reducing loads, and endurance testing of full scale components on testing facilities.

560 **(FRA—146-7) Crack initiation and arrest in a SA 508 CL3 cylinder under liquid nitrogen thermal shock experiment.** Houssin, B.; Pelissier-Tanon, A.; Sollogoub, P.; Robisson, F. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Aug 1983. 8p. (CONF-830805—100). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752868.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

Three successive initiation and arrest of cleavage crack propagation occured in a large SA 508 cl 3 cylinder during a liquid nitrogen thermal shock. The cylinder of internal diameter 920 mm, thickness 230 mm and height 1000 mm was provided with an initial 17 mm deep longitudinal flaw prepared by electron beam welding, followed by hydrogen charging. Heat exchange was enhanced by a rubber cement coating promoting nucleate boiling instead of film boiling of the nitrogen at the inner surface. The crack initiation and arrest profiles were determined from the markings on the fractured surfaces. The values of initiation stress intensity factors computed for the through wall temperature distributions measured at the times of the three propagation events are compared to a set of toughness data obtained by laboratory tests on the same and very similar forgings. Special tests on CT specimens precracked with the electron beam and hydrogen charging technique showed no significant differences with the usual fatigue precracking.

561 **(FRA—147-2) Presentation of the RCC-M design and construction rule.** Quero, J.R. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Mar 1983. 4p. (In French). (CONF-8303148—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752865.

From Meeting on standardization of nuclear power plant design and construction; Paris, France (23 Mar 1983).

Presentation of the French rules for design and construction of nuclear power plant components: stress resistance, material choice, fabrication and quality control, control methodology etc. covering equipments such as pressurized components (tanks, exchangers, pipes, pumps, valves and fittings), internal and support reactor elements and non pressurized small devices.

562 **(FRA—147-3) RCC utilization evaluation from the stand point of trade with foreign customers and their safety authorities.** Yvon, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Mar 1983. 7p. (In French). (CONF-8303148—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752864.

From Meeting on standardization of nuclear power plant design and construction; Paris, France (23 Mar 1983).

Analysis of the perception by the foreign customers of the RCC reference document value (French design and construction rules for reactor components) and of the interest that these documents present, as an indication of the French experience, in the export negotiating of French nuclear power plants. Difficulties raised by the concurrence of American rules, problems of updating RCC.

563 **(FRA—147-4) Practice of the RCC-C for fabrication of large hardware equipments.** Gandrey, L. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Mar 1983. 7p. (In French). (CONF-8303148—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752867.

From Meeting on standardization of nuclear power plant design and construction; Paris, France (23 Mar 1983).

Presentation of FRAMATOME experience concerning practice of RCC-M (French design and construction rules for nuclear power plant components) to the fabrication of large equipments for primary circuits (tanks, vapor generators, pressurizers): utilization of the design and calculation rules, development of welding, enhancement of various controls (e.g. ultrasonic controls); study of their adaptability, occured problems, required investments, etc.

564 **(GKSS—84/E/53) Field theoretical finite element method to provide theoretical calibration curves for the electrical direct-current potential crack-monitoring system as applied to a three-dimensional fracture mechanics specimen with surface crack.** Dietrich, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1984. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752709.

The basic concepts of the finite element method are explained. The results are compared to existing calibration curves for such test piece geometries derived using experimental procedures.

565 (INIS-mf—9905, pp 190-197) **Organisation and testing aids for welding and surfacing jobs in manufacture and assembly of nuclear power plant equipment.** Pelikan, J.; Hampejs, M.; Kesl, J. (Skoda, Plzen (Czechoslovakia)). 1983. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091. (CONF-8310399—).

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

The qualification demands are defined for checking welding and surfacing work. The contribution of ultrasonic crack detection is discussed. Tests of an X-ray/TV chain are made to simplify and speed up crack detection. The evaluation of the results of crack detection is discussed.

566 (INIS-mf—9910-Vol.1, pp 20-23) **Role of orifice and non-condensable gas on the two-phase natural circulation in a horizontal heating-vertical condensing loop.** Tran, F.B.P.; Chang, J.S. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Engineering Physics). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The role of orifice and non-condensable gas on the two-phase natural circulation in a horizontal heating-vertical condensing figure of zero loop has been studied experimentally. Results show that the flow observed during the natural circulation is oscillating. The frequency of oscillation, net flow rate, and heat removal capability in vertical section are significantly influenced by the presence of the non-condensable gas and the orifice in the loops. A possible mechanism leading to this experimental observation is discussed.

567 (INIS-mf—9910-Vol.1, pp 62-92) **Comparison of subchannel code COBRA-III-C and COBRA-IV with experimental data obtained on two laterally interconnected flows.** Tapucu, A.; Troche, N. (Ecole Polytechnique, Montreal, Quebec (Canada). Inst. de Genie Nucleaire); Sami, S. (Ecole Polytechnique, Montreal, Quebec (Canada)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

In this research, the hydrodynamic behaviour of two laterally interconnected subchannels with different flow conditions has been studied and the experimental data obtained on pressures and flow rates in the channels have been compared with the predictions of the COBRA-III-C and COBRA-IV subchannel codes. The experiments were conducted under single phase flow conditions. Good agreement between the COBRA-IV predictions and the experimental data has been obtained especially for moderate flow rate differences between the channels at the beginning of the interconnected region.

568 (INIS-mf—9910-Vol.2, pp 41-70) **Development of an explicit correlation for vertical rewetting velocity.** Sollychin, R.; Bonalumi, R.A.; Andrews, D.G. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

This paper describes a special application of a conduction-controlled mechanism model to the problem of vertical rewetting. Through an analytical study of the major parameters suggested by the model, the difficulties in determining the Leidenfrost temperature Tsub(o) and the heat transfer coefficient, h, have been avoided. An explicit semi-empirical correlation for the rewetting velocity, u, has been developed that fits very closely the available experimental data. The effects of the inlet coolant mass velocity G and subcooling ΔTsub(sub), which have not been fully understood before, have now been explicitly included in the correlation. This confirms the adequacy of the conduction-controlled mechanism model for vertical rewetting phenomena.

569 (NUREG/CR—1890) **ABS, SRSS and CDF response combination evaluation for Mark-III containment and drywell structures.** Philippacopoulos, A.J. (Brookhaven National Lab., Upton, NY (USA)). Jun 1982. Contract AC02-76CH00016. 442p. (BNL-NUREG—51328). NTIS, PC A19/MF A01 - GPO. File Number TI86000961.

The behavior of a representative Mark III containment and its drywell is investigated with respect to their structural capacity when subjected to various load combinations that may be expected during their lifetime. Mathematical models based on finite element idealization procedures are developed and verified. These include three-dimensional finite element models and the so-called stick models of the Mark III containment system. The latter are employed for soil-structure interaction analysis. Various BNL computer codes are utilized to evaluate structural responses. A set of dynamic loads originating from LOCA, SRV and EARTHQUAKE are compiled from reviewing the current literature. The combinations are performed by employing both the Absolute Sum (ABS) and Square-Root-of-the-Sum-of-the-Squares (SRSS) methods. In addition a probabilistic evaluation of the combination outcome is carried out by using a Monte-Carlo technique. This is done by generating cumulative distribution functions (CDF's) expressing the non-exceedance probability (NEP) level of the maxima of the combinations. The results from a large number of combination cases are demonstrated.

570 (NUREG/CR—4141) **Containment purge and vent valve test program final report.** Steele, R. Jr.; Watkins, J.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1985. Contract AC07-76ID01570. 72p. (EGG—2374). NTIS, PC A04/MF A01 - GPO. File Number TI86001823.

The test program investigated valve functionality and leak integrity. Three nuclear designed butterfly valves typical of those used in domestic nuclear power plant containment purge and vent applications were tested. For a comparison of response, two valves of the same size with differing internal designs were tested. For extrapolation insights, a larger sized valve was also tested. The valve experiments were performed with various piping configurations and valve disc orientations to the flow to simulate various installation options in field applications. As a standard for comparing the effects of the installation options, testing was also performed in a standard ANSI test section. Dynamic flow tests were performed over the range of a design basis accident. Leak integrity testing was also performed and extended into severe accident conditions. Analysis of the test results produced a technical basis to assess industry purge and vent valve closing torque extrapolation methodology and quantified the influence of worst case piping geometry on valve torque response. It was also determined that some valve designs will leak in single isolation when exposed to design basis and severe accident environments.

571 (PNL-SA—13101) **Light-ion induced hardening kinetics in irradiated ferritic steels.** Henager, C.H. Jr.; Simonen, E.P. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 9p. (CONF-850902—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001673.

From 2. international symposium on environmental degradation of materials in nuclear power systems--water reactors; Monterey, CA, USA (9 Sep 1985).

Radiation hardening was observed during creep of ferritic alloys with and without copper additions. Irradiation creep testing was combined with microhardness testing to study changes in creep strength and yield stress of two ferritic alloys. Post-irradiation creep rates and post-irradiation microhardness data confirm that significant radiation hardening occurred in both ferritic alloys due to the 673 K deuteron bombardment of 0.05 dpa. The observed hardining is attributed to growth of interstitial loops and not to growth of copper precipitates. The lack of cascade damage from light-ions may account for the lack of precipitation effects. 17 refs., 4 figs., 5 tabs.

572 **Scaling criteria for two-phase flow loops and their application to conceptual 2 X 4 simulation loop design.** Kocamustafuogullari, G.; Ishii, M. (Univ. of Wisconsin-Milwaukee, Dept of Mech Eng., Milwaukee, WI). *Nuclear Technology;* **65**: No. 1, 146-160(Apr 1984).

Scaling criteria for a natural circulation loop under single- and two-phase flow conditions are derived from the fluid balance equations, boundary conditions, and solid energy equations. For a single-phase flow case, the continuity, integral momentum, and energy equations in one-dimensional area-averaged forms were used. For a two-phase flow case, the one-dimensional drift-flux model obtained from the short time temporal averaging and the sectional area averaging was used. The scaling criteria are applied to a conceptual design of a 2 X 4 loop facility for simulating the Babcock & Wilcox Company 177 NSSS lowered loop plant design. Numerical calculations performed to meet the similarity requirement indicated that the most severe condition in terms of the thermohydraulic simulation is imposed by the friction number requirement over the hot leg section. Therefore, a solution for the similarity criteria based on the hot leg was presented. For three separate circumstances, it was shown that a solution in the form of the length ratio as a function of the area ratio is feasible in each case.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 1184

2204 Control Systems

REFER ALSO TO CITATION(S) 559, 601

573 **(CEA-CONF—7531) Calculation of the "seeing length" of an in-core neutron detector in a BWR.** Kosaly, G.; Sanchez, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1984. 10p. (CONF-841017—13). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752829.

From Specialists' meeting on reactor noise - SMORN IV; Dijon, France (15 Oct 1984).

Using the correlation of the fluctuating signals of in-core neutron detectors located in the same instrument guide tube one can measure the void-propagation velocity in the bundles. Since the instrument guide tubes are located in the bypass region between four bundles, the neutron detector "sees" the void-fraction fluctuations in different regions of the neighboring bundles with different weights. Neutrons transport theory methods were used to evaluate the weight-function that determines the signal contribution of disturbances acting at different spatial regions. The weight function results have been combined with subchannel predictions to evaluate the cross-spectrum between two in-core detectors.

574 **(CEA-CONF—7532) Principle governing the simple determination of characteristic parameters for the supervision of vibratory behaviour.** Carre, J.C.; Epstein, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1984. 9p. (In French). (CONF-841017—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752819.

From Specialists' meeting on reactor noise - SMORN IV; Dijon, France (15 Oct 1984).

The aim of supervision of the vibratory behaviour is the early detection of an anomaly, i.e. of any deformation liable to appear on the resonances of interest: rise or fall in maximum power, change in central frequency, widening or narrowing of half-width. This study shows that it is possible to detect easily with a spectral power density noise and a limited number of values and variances calculated on a few bands, the eventual deformation of the frequency curve. This simple method is easy to install with an on-line system and is able to process a great number of signals.

575 **(CONF-8510161—1) Component Configuration Control System: an application of logic programming.** Stratton, R.C.; Town, G.G. (Argonne National Lab., IL (USA); Central Washington Univ., Ellensburg (USA). Dept. of Computer Science). 1985. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018455.

From Artificial intelligence in engineering conference; Washington, DC, USA (21 Oct 1985).

A computer application system is described which provides nuclear reactor power plant operators with an improved decision support system. This system combines traditional computer applications such as graphics display with artificial intelligence methodologies such as reasoning and diagnosis so as to improve plant operability. This paper discusses the issues, and a solution, involved with the system integration of applications developed using traditional and artificial intelligence languages.

576 **(UCRL—93293) Use of logic flowgraph models in a computer aided process analysis and management system.** Guarro, S.B.; Okrent, D. (California Univ., Los Angeles (USA). School of Engineering and Applied Science; Lawrence Livermore National Lab., CA (USA)). Jul 1985. Contract W-7405-ENG-48. 12p. (CONF-850903—22). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000740.

From International topical meeting on computer applications for nuclear power plant operation and control; Pasco, WA, USA (8 Sep 1985).

The development of a multi-function computer-aided process analysis and management (CAPAM) system, to be implemented in nuclear power plant control rooms, is proposed and discussed. The design goals identified for such a system are early disturbance detection and diagnosis, accompanied by identification of the best possible recovery actions or alternative success paths. The CAPAM structure is articulated in three functional levels with dedicated CRT displays. Increasing amount of diagnostic or recovery information is made available to the operators at the lower display levels. Probabilistic safety margins to the loss of important safety functions may be also calculated. The proposed implementation of the CAPAM concept is based on the use of logic flowgraph networks for the more detailed system modeling. Examples of such an implementation are given. 7 refs., 3 figs., 2 tabs.

577 **Neutron noise analysis techniques in nuclear power reactors.** Munoz-Cobo, J.L.; Sanchis, R.; Verdu, G. (Universidad Politecnica de Valencia (Spain)); Marxh-Leuba, J. (Oak Ridge National Lab., TN (USA)). *Energia Nuclear (Madrid);* **29**: No. 153, 15-28(1985). (In Spanish).

The main techniques used in neutron noise analysis of BWR and PWR nuclear reactors are reviewed. Several applications such as control of vibrations in both reactor types, determination of two phase flow parameters in BWR and stability control in BWR are discussed with some detail. The paper contains many experimental results obtained by the main author of this paper.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 495, 716, 749, 1307, 1309, 1317

578 **(NUREG—1094-Final) Final Environmental Statement related to the operation of Beaver Valley Power Station, Unit 2 (Docket No. 50-412).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1985. 306p. NTIS, PC A14/MF A01 - GPO. File Number TI86900116.

This Final Environmental Statement contains the second assessment of the environmental impact associated with Beaver Valley Power Station Unit 2 pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. This statement examines the environment, environmental consequences and mitigating actions, and environmental benefits and costs, and concludes that the action called for is the issuance of an operating license for Beaver Valley Unit 2.

579 **(NUREG/CR—1530-Pt.2) Potential radiological impact of tornadoes on the safety of Nuclear Fuel Services' West Valley Fuel Reprocessing Plant. 2. Reentrainment and discharge of radioactive materials.** Davis, W. Jr. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract AC05-84OR21400. 86p. (ORNL/NUREG—80/P2). NTIS, PC A05/MF A01 - GPO. File Number TI86000954.

This report describes results of a parametric study of quantities of radioactive materials that might be discharged by a tornado-generated depressurization on contaminated process cells within the presently inoperative Nuclear Fuel Services' (NFS) fuel reprocessing facility near West Valley, New York. The study involved the following tasks: determining approximate quantities of radioactive materials in the cells and characterizing particle-size distribution; estimating the degree of mass reentrainment from particle-size distribution and from air speed data presented in Part 1; and estimating the quantities of radioactive material (source term) released from the cells to the atmosphere. The study has shown that improperly sealed manipulator ports in the Process Mechanical Cell (PMC) present the most likely pathway for release of substantial quantities of radioactive material in the atmosphere under tornado accident conditions at the facility.

580 **(NUREG/CR—2215) LMFBR Aerosol Release and Transport Program quarterly progress report, October-December 1980.** Kress, T.S.; Tobias, M.L. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract AC05-84OR21400. 22p. (ORNL/TM—7884). NTIS, PC A02/MF A01 - GPO. File Number TI86000884.

This report summarizes progress for the Aerosol Release and Transport Program sponsored by the Division of Reactor Safety Research of the Nuclear Regulatory Commission for the period October-December 1980. Topics discussed include (1) recent capacitor discharge vaporization (CDV) underwater tests conducted in the Fuel Aerosol Simulant Test (FAST) Facility; (2) a CDV test in the Containment Research Installation-III Facility in an argon atmosphere to investigate a possible method for improving aerosol yield; (3) a summary of a letter report on FAST water test results and proposed experimentation; (4) modifications to the Nuclear Safety Pilot Plant (NSPP) Facility to accommodate future experiments in steam environments expected to occur in light-water reactor accident conditions; and (5) implementation of the University of Virginia FAST experiment code, UVABUBL.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 475, 481, 506, 745, 1275

581 **(AD—469554/0/XAB) ASTR rod-drive replacement. Technical report, 1 October 1963-31 December 1964.** Pancoast, J.T.; Dickenson, C.W. (General Dynamics Corp., Fort Worth, TX (USA). Nuclear Aerospace Research Facility). Jul 1965. 54p. (FZK—226). NTIS, PC A04/MF A01.

The 10-MW ASTR rod-drive mechanisms, originally designed for an airborne environment, were becoming difficult to repair because of high radiation levels and inability to procure direct-replacement spare parts. Failure of the original mechanism is attributed to (1) misalignment, (2) component failure, (3) water damage, and (4) radiation damage. With the reactor environment considerably different from that existing during the flight program, the mechanisms were no longer exposed to the g forces, extreme vibrations, and low temperatures for which they were designed. However, the mechanisms were required to function under varying depths of water of from 0 to 30 ft, under a core pressure of 75 psi, and at water temperatures of up to 185 F. Therefore, a program was initiated to develop a replacement-drive mechanism. This program involved prototype design and fabrication, testing, and installation and checkout on the ASTR. The new rod-drive mechanism basically is a 115-V, 60-cycle-powered rack and pinion type. The reactor operational checkout program resulted in several design changes being made in the mechanical interlock, shaft seals, electrical harness, and magnet-not-in-contact switch. These changes were incorporated in the nine mechanisms that were fabricated. The rod-drive mechanisms in their final configuration performed well throughout reactor operation.

582 **(AD—489160/2/XAB) Meteorological support for NARF Reactor operations. Rept. for 1 October 1964-30 September 1965.** Bradbury, H.G. (General Dynamics Corp., Fort Worth, TX (USA). Nuclear Aerospace Research Facility). Aug 1966. 52p. (FZK—274). NTIS, PC A04/MF A01.

This report covers the meteorological data generated by the Atmospheric Physics Facility (APF) in support of the Nuclear Aerospace Research Facility (NARF), Fort Worth Division of General Dynamics. Information is detailed on the data-acquisition system and on the operation, the data production, the coding, the processing and the application of the data to nuclear safety and climatology at NARF. The 110-ft instrumented tower and the automatic digital recorder, which became operational in early 1965, provide continuous recordings of meteorological conditions, including wind, temperature, net thermal radiation, and air turbulence at various levels of from 1 to 32 meters above grade. The data are used as input for the NARF diffusion climatology in the concern for environmental nuclear safety under the NARF program. Wind and lapse-rate (air stability) data acquired by the APF during May through September 1965 are presented. This information is to be applied in the evaluation of the atmospheric diffusion parameters at the NARF reactor site.

583 **(CONF-8410173—13) RERTR Program fuel testing and demonstration: an update.** Snelgrove, J.L. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001798.

From International meeting on reduced enrichment for research and test reactors; Argonne, IL, USA (14 Oct 1984).

The irradiation and postirradiation examination of high-density, reduced-enrichment miniplates and full-sized elements are continuing under the RERTR Program. The emphasis is currently being placed on determining uranium-density/fission-density limits for the highest-density silicide fuels. One whole core demonstration is nearing completion in the FNR, and another, using U_3Si_2 fuel, is scheduled to begin in the ORR during the next year. This paper will summarize the progress made during the past year.

584 **(DOE/ER/10725—2) University Reactor sharing grant. Final technical report, September 1, 1984-August 31, 1985.** (Missouri Univ., Columbia (USA). Research Reactor Facility). 1985. Contract FG02-80ER10725. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001630.

Costs for reactor services are generally based upon the amount of space, time and service position used. A breakdown of reactor irradiation and service costs is given. (DLC)

585 **(HEDL-SA—3334) Large remote manipulator operating and maintenance experience at IEM cell.** Hicks, D.F.; McGuinness, P.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 1985. Contract AC06-76FF02170. 9p. (CONF-851115—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018493.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Interim Examination and Maintenance (IEM) Cell at the Fast Flux Test Facility (FFTF) has two large Electro-Mechanical Manipulators (EMM's). These manipulators are used for cell operations (processing of reactor core components) as well as general cell maintenance. From our eleven years of operation and maintenance experience with these large EMM's, we have learned many lessons concerning manipulator design. This paper describes the IEM Cell EMM design features and discusses operating and maintenance experience at the IEM Cell.

586 **(HEDL-SA—3339-FP) Fuel assembly duct cutting in the FFTF/IEM Cell.** Gibbons, P.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 1985. Contract AC06-76FF02170. 9p. (CONF-851115—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018475.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Two mill type slitting cutters are used in the Fast Flux Test Facility (FFTF) Interim Examination and Maintenance (IEM) Cell during the disassembly sequence of a Driver Fuel Assembly. This disassembly is necessary so that selected parts may be examined both in the IEM Cell and elsewhere. The cutters have been in use for two years. During this time eight Driver Fuel assemblies have been taken apart in the IEM Cell. The cutters' operating philosophy and characteristics, as well as lessons learned from a significant equipment failure are presented. 1 ref., 6 figs., 1 tab.

587 **(HEDL-TME—85-16) Comparison of calculational methods for liquid metal reactor shields.** Carter, L.L.; Moore, F.S.; Morford, R.J.; Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1985. Contract AC06-76FF02170. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86000881.

A one-dimensional comparison is made between Monte Carlo (MCNP), discrete ordinances (ANISN), and diffusion theory (MIDX) calculations of neutron flux and radiation damage from the core of the Fast Flux Test Facility (FFTF) out to the reactor vessel. Diffusion theory was found to be reasonably accurate for the calculation of both total flux and radiation damage. However,

for large distances from the core, the calculated flux at very high energies is low by an order of magnitude or more when the diffusion theory is used. Particular emphasis was placed in this study on the generation of multitable cross sections for use in discrete ordinates codes that are self-shielded, consistent with the self-shielding employed in the generation of cross sections for use with diffusion theory. The Monte Carlo calculation, with a pointwise representation of the cross sections, was used as the benchmark for determining the limitations of the other two calculational methods. 12 refs., 33 figs.

588 **(LA-UR—85-3341) Transient heat pipe investigations for space power systems.** Merrigan, M.A.; Keddy, E.S.; Sena, J.T. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 19p. (CONF-8509153—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000813.

From 2. SP-100 program integration meeting; Denver, CO, USA (17 Sep 1985).

A 4-meter long, high temperature, high power, molybdenum-lithium heat pipe has been fabricated and tested in transient and steady state operation at temperatures to 1500 K. Maximum power throughput during the tests was approximately 37 kW/cm^2 for the 1.4 cm diameter vapor space of the annular wick heat pipe. The evaporator flux density for the tests was 150.0 W/cm^2 over a length of 40 cm. Condenser length was approximately 3.0 m with radiant heat rejection from the condenser to a coaxial, water cooled radiation calorimeter. A variable radiation shield, controllable from the outside of the vacuum enclosure, was used to vary the load on the heat pipe during the tests. 1 ref., 9 figs.

589 **(ORNL/TM—9709) Report of the Materials Irradiation Facilities Improvements Committee.** Alexander, C.W.; Conlin, J.A.; Hurt, S.S. III; Moon, R.M. Jr.; Newman, E. Jr.; Rowcliffe, A.F.; Thoms, K.R.; West, C.D. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 60p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001447.

Engineering materials irradiations form a substantial program at Oak Ridge National Laboratory (ORNL), relying mainly on the High-Flux Isotope Reactor (HFIR) and the Oak Ridge Research Reactor (ORR). The HFIR neutron flux is high, but the reactor was not designed for materials irradiations; the lack of instrumented positions in the target region and the small size and limited number of positions in the high-flux region immediately outside the control plates pose particular disadvantages for this kind of research. Relatively minor modifications to the HFIR, at a cost of less than $2 million, would give it a first-class materials irradiation capability, capable of undertaking most of the experiments now performed at the ORR in one-half to one-third the time. The lack of comprehensive neutronics calculational capability at ORNL is a major drawback for experimenters and for the reactor operators, making it difficult to assess the feasibility of proposed new experiments or reactor improvements. The Operations Division should acquire the necessary computational capability, making use of new computational techniques and the newly available, more powerful computers as necessary. As a long-term prospect, when the proposed Center for Neutron Research (CNR) is build and the HFIR is no longer needed for neutron-scattering work and isotope production, the HFIR core could be replaced by a general purpose materials testing reactor core; the result would be the world's finest materials testing facility for less than one-tenth the cost of a new reactor. The value of such a scheme will depend on the national need for materials irradiation testing and isotope production at the time that the CNR is commissioned.

590 **Reactor sharing experience at the MIT research reactor.** Clark, L. Jr.; Fecych, W.; Young, H.H. (Massachusetts Institute of Technology, Cambridge). *Transactions of the American Nuclear Society;* **49 Suppl. 2**: 34-35(1985). (CONF-850894—).

From 12. biennial conference on reactor operating experience "maintenance and modifications for availability and efficiency"; Williamsburg, VA, USA (4 Aug 1985).

This paper provides a number of examples of how educational institutions in the Boston area and elsewhere that do not possess nuclear reactors for training and research purposes have successfully enriched their programs through utilization of the Massachusetts Institute of Technology Research Reactor (MITR) with assistance from the Reactor Sharing Program of the US Department of Energy (DOE).

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 542

591 (INIS-mf—9910-Vol.2, pp 71-91) **Void fractions for water in a cosine-distribution heated vertical annulus at low pressures and velocities.** Salcudean, M.; Tahir, A.; Abdullah, Z. (Ottawa Univ., Ontario (Canada). Dept. of Mechanical Engineering); Rogers, J.T. (Carleton Univ., Ottawa, Ontario (Canada). Faculty of Engineering). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

A 2-MW version of the 20 kW SLOWPOKE research reactor is being developed by Atomic Energy of Canada Ltd. for low temperature industrial or space heating applications. A design target for the up-rated SLOWPOKE reactor is to achieve similar inherent safety against power excursions to that achieved in the present SLOWPOKE reactors. To accomplish this objective at the relatively high power density of the up-rated SLOWPOKE, the designers must rely on a strong negative void coefficient. An experimental program to measure the onset of significant void (OSV), void fractions, and critical heat fluxes under relevant conditions was undertaken jointly by researchers at the University of Ottawa and Carleton University under contract to Atomic Energy of Canada Ltd. This paper describes the results obtained for OSV and void fractions in a vertical annulus with a cosine axial heat flux distribution. A few measurements of OSV and void fractions in uniformly-heated test sections are also presented for comparison.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 146, 240, 241, 582, 1258, 1435, 1935

592 **(BMI—1985-069) Computations with the FIPLOC MOD 1/83 program on the methyl iodide and aerosol distribution of number A-5 and A-11 containment systems experiments.** Weber, G.; Jahn, H. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1985. 133p. (In German). (GRS-A—1011). NTIS (US Sales Only), PC A07/MF A01. File Number DE85752718.

In the present final report different computations regarding two containment systems experiments are documented by the FIPLOC program. The spatial distribution for methyl iodide and a cesium aerosol in consequence of natural, undisturbed flow processes in the model containment measuring 850 m^3 and divided into three rooms was calculated. By improved discretisation and precise simulation of the course of the experiments the measuring results were closely confirmed. The characteristic courses of the two experiments, which differ mainly by the variation of steam feed, are analytically verified by means of the computation results and interpreted. The verification calculations carried through for the FIPLOC code clearly demonstrate the necessity of simultaneous simulation of distribution and deposition phenomena. Future improvements of the model are planned both for the thermohydraulic part, from which especially more precise indications are to be obtained regarding local saturation conditions, and for the aerosol part, which is to be enlarged in such a manner that also the time and site-related changes in particle size can be simulated by condensation/evaporation and coagulation.

593 **(BMI—1985-073) Investigations on transient distribution of hydrogen and vapor in single spaces of the containment in case of high pressure failure of the reactor pressure vessel passing a core meltdown accident.** Tiltmann, M. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1985. 62p. (In German). (GRS-A—938). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752717.

For the investigation of the sequences of a hypothetical core meltdown accident, the primary interest is directed towards the integrity of the containment. In case of insecurity, the valid interests become then the probable time period of failure and the type of failure of the containment (SB). Within the scope of investigations on possible loads exerted on containment during the process of core meltdown under high system pressure, the following question has to be answered. The question was whether an overlapping of the loads caused by possible local H_2-burning or detonation occurred in addition to the loads (due to spontaneous release of mass and energy) exerted on the steel shell of the containment by the failure of primary circuit in the region of the bottom of the reactor pressure vessel (RPV). Therefore during the process of core meltdown after the failure the propagation behavior of stored masses of hydrogen in regions surrounding the reactor cavity was examined and the formed concentration ratios of hydrogen, steam and air at 22 different rooms during the transient relief phase were investigated. Under the assumption of homogeneous distribution of gaseous fractions in the individual rooms, no flammable gas mixtures were confirmed within the time range given for investigation. Therefore the load exerted following the spontaneous release of masses and energy due to failure of RPV (stem spike) cannot be overlapped with the same resulting due to process of H_2-burning.

594 **(BNL-NUREG—29831) Class of dependent failures.** Papazoglou, I.A. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 9p. (CONF-811103—26). NTIS, PC A02/MF A01 - GPO. File Number TI86000959.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

The purpose of this paper is to analyze the effect on the reliability of redundant systems of a class of dependent failures that are due to causes internal to the system (sympathetic failures). A general Markovian model that can incorporate both common cause (externally generated) and sympathetic failures is developed. The model includes the β-factor model and the Marshall-Olkin model as special cases. Three specialized versions of the general model are presented. It is shown that sympathetic failures can restrict the achievable reliability of a system beyond the limit set by common cause failures.

595 **(BNL-NUREG—37037) Evaluation of BWR emergency procedure guidelines for BWR ATWS using RAMONA-3B code.** Neymotin, L.; Slovik, G.; Cazzoli, E.; Saha, P. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 12p. (CONF-851007—13). NTIS, PC A02/MF A01 - GPO. File Number TI86000630.

From 3. international meeting on reactor thermal hydraulics; Newport, RI, USA (15 Oct 1985).

An MSIV Closure ATWS calculation for a typical BWR/4 (Browns Ferry, Unit 1) was performed using the RAMONA-3B code which is a BWR systems transient code combining three-dimensional neutronic core representation with multi-channel one-dimensional thermal hydraulics. The main objective of the study was to perform a best-estimate evaluation of the recently proposed Emergency Procedure Guidelines for Anticipated Transients Without Scram (ATWS). Emphasis was placed on evaluating the effects of lowering the downcomer water level to the Top of Active Fuel (TAF) and vessel depressurization. The calculation was run up to approximately 1200 seconds. Both actions, namely, lowering the water level and vessel depressurization, lowered the reactor power to some extent. However, the pressure suppression pool water temperature still reached approximately 90°C (potential High Pressure Coolant Injection (HPCI) pump seal failure temperature) in twenty minutes. Thus, other actions such as boron injection and/or manual control rod insertion are necessary to mitigate a BWR/4 Main Steam Isolation Valve (MSIV) closure ATWS. 19 refs., 14 figs., 3 tabs.

596 **(CEA-CONF—7652) Presentation of the NABE calculation code.** Dufresne, J.; Fermandjian, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 21p. (CONF-8406285—1; DAS—96). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752830.

From BMFT-CEA-Department of Energy meeting; Argonne, IL, USA (25 Jun 1984).

The purpose of the NABE code is to follow up the physical and chemical parameters of a concrete cell when large amounts of sodium are released by accident in the reactor building. The code contains several modules: behaviour of the concrete, heating-up, water and CO_2 release, reactions between liquid and vapor sodium with the concrete breakdown products, combustion of sodium and hydrogen (water), power released by the fission products in the liquid, the gas and the concrete, behaviour of the atmosphere of the cell (pressure, temperature, leaks), sodium vaporization and boiling, and condensation on the cold walls.

597 **(CEA-CONF—7653) Containment loading during severe core damage accidents.** Fermandjian, J.; Evrard, J.M.; Cenerino, C.; Berthion, Y.; Carvallo, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 15p. (CONF-840914—31). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752833.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The objective of the article is to study the influence of the state of the reactor cavity (dry or flooded) and of the corium coolability on the thermal-hydraulics in the containment in the case of an accident sequence involving core melting and subsequent containment basemat erosion, in a 900 MWe PWR unit. Calculations are performed by using the JERICHO thermal hydraulics code.

598 **(CEA-CONF—7654) Introduction of operator actions in the event trees.** Bars, G.; Lanore, J.M.; Villeroux, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 9p. (CONF-840914—32; DAS—98). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752834.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

In the PRA in progress in France for a 900 MW PWR plant, an effort is done for introducing operator actions during accident sequences. A first approach to this complex problem relies on an extensive use of existing methods and knowledge in diverse fields. Identification of actions is based on the operating procedures, and in particular on the existence of special emergency procedures which define the optimal actions during severe accidents. This approach implies the introduction in the event trees of the notion of procedure failure. Quantification of the corresponding probabilities leads to several problems including physics of the sequences, systems availability and human behaviour for decision making and actions. This treatment is illustrated by the example of the small break event tree.

599 **(CEA-CONF—7655) Systematic evaluation of safety in old nuclear power plants.** Dredemis, G.; Fourest, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 12p. (In French). (CONF-840914—33; DAS—99). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752835.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

A systematic evaluation program of the early nuclear power plant has been conducted by the French safety authorities. This examination is concerned with the remodelling of safety documents (safety reports, operation general regulations, incident and accident procedures, internal emergency plans and organization manuals for quality), with an analysis of the operating experience in frequently utilized circuits and with a systematic analysis of safeguards circuits. These evaluations are based on the experience of the Ar-

dennes nuclear power plant, operating 15 years. This paper also describes the main studies and modifications undertaken in this power plant.

600 **(CEA-CONF—7658) In-pile investigations at the PHEBUS facility of the behavior of PWR-type fuel bundles in typical L.B. LOCA transients extended to and beyond the limits of ECCS criteria.** Duco, J.; Reocreux, M.; Tattegrain, A.; Berna, P.; Legrand, B.; Trotabas, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 12p. (CONF-840914—29; DAS—102). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752817.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

An in-pile investigation is currently carried out at the PHEBUS facility of the behavior of .8 m active height, 25-rod PWR-type fuel bundles during simulated large-break LOCA (L.B. LOCA) reactor transients. A first series of six tests using pressurized rods is to be completed by the end of 1984, relative to a conservatively calculated 2-peak cladding temperature transient at the hot point, as considered in the French 900 MW(e) PWR standard safety report. The severity of such a transient has been increased in the tests so as to check the bundle behavior at the limits of the first two NRC ECCS criteria, which were, in fact, locally exceeded in one test. Three of the tests are reported on hereunder. Short coplanar cladding balloonings were observed at the hot point level, which resulted in maximum flow blockage ratios of about 50%. Severe cladding embrittlement against thermal shock and subsequent handling was observed in the test where the criteria were exceeded. Prediction of the overall thermal-hydraulic behavior in the bundle was good, using the RELAP 4 MOD 6 code. Cladding strains are generally overevaluated by codes such as FRAPT 4 or CUPIDON, which currently do not take into account azimuthal cladding temperature gradients. Other L.B. LOCA test series are envisaged from 1986 on, based on transients calculated with "physical" models.

601 **(CEA-CONF—7659) Control rod guide tube support pin cracking at French plants.** Gros, G.; Perrault, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 18p. (CONF-840914—30; DAS—103). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752818.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

Several ruptures of support pins have accured in France; some damage was caused to steam generators. The failures were caused by Inconel X 750 stress corrosion; several parameters are assessed. Two safety concerns are analysed: potential control rod guide tube misalignment and consequence of a support pin as a loose part. The conclusion is that a pin failure is of limited safety significance, at least at short term, but the availability can be seriously impaired. That leads to conduct inspections during refueling shutdowns, incorporate a loose parts continuous monitoring system, develop an improved pin design and replace the pins at existing plants.

602 **(CEA-CONF—7660) Characterization of the pressure field induced by the explosions in air of a hydrocarbon-air mixture with slow deflagration or fast deflagration.** Garnier, J.L.; Perrot, J.; Brossard, J.; Di Fabio, N.; Lannoy, A.; Desbordes, D.; Leyer, J.C.; Saint-Cloud, J.P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 12p. (CONF-8410331—1; DAS—104). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752831.

From Seminar on the results of the indirect action research program: safety of thermal water reactor; Brussels, Belgium (1 Oct 1984).

The present research contract, carried out in the framework of a French working group CEA-EDF-ENSMA, was divided into four phases: 1) Phase 1: Scaling effects on a pressure field generated by spontaneous accelerations of deflagrations in a homogeneous medium: these "CHARLES" tests performed on completely unconfined charges of ethylene-air and acetylene-air mixture (V approximately= 12 m^3) have demonstrated the high sensitivity of the pressure field to the flame acceleration, particularly at the end of the propagation. 2) Phase 2: Effect of a sudden discontinuity in the concentration of the combustible gas on the deflagration speed in a heterogeneous medium: this discontinuity was obtained using two concentric latex balloons, filled with different hydrocarbon concentrations and also destroyed before firing. 3) Phase 3: Study of pseudo-detonation modes for the explosion of spherical ethylene-air mixtures: these modes were sought by increasing an explosive plastic mass associated to the igniter. 4) Phase 4: Study of the influence of cloud shape, ignition point location and simple obstacles in the flame path on the pressure field generated by the explosion. A retractable enclosure was designed, built and unfortunately destroyed by the second test.

603 **(CEA-CONF—7775) Review on individual neutron dosimetry.** Portal, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1983. 6p. (In French). (CONF-8212104—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752815.

From Mesucora congress; Paris, France (8 Dec 1982).

Up to now, nuclear energy workers in relation to neutron radiations were few. Fast development of nuclear energy lead us to study, for the future, individual dosimetry techniques which are autonomous, more accurate and cheaper. The future dosemeter will be both a fast neutron dosemeter and slow neutron dosemeter. The different current studies concerning this "composite" dosemeter are described. In 1984-1985, operation of a "non-homogeneous, composite" dosemeter is foreseen; later on, an "homogeneous composite" dosemeter, that is to say a dosemeter which needs the same basis techniques.

604 **(CEA-CONF—7790) Star rover. Man and risk management.** Chertman, F.; Pages, J.P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1982. 5p. (In French). (CONF-8210147—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752897.

From 3. symposium on reliability and maintenance; Toulouse, France (18 Oct 1982).

How to take into account man to improve the safety of large systems. In safety management risk is often assimilated to the triplet: - event probability, -, consequences, - consequence evaluation the individual is confronted to the situation and himself. Failures are better understood taking into account that at each moment an individual reacts not only in function of problems to solve (where know low intervenes) but also in function of affective dimensions. This paper is an attempt to isolate some dimensions characterizing man and of importance in the management of large system safety day after day.

605 **(CEA-CONF—7841) French experience in seismic risk analysis and associated research works.** Mohammadioun, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 18p. (In French). (CONF-8410333—1; DAS—115; IAEA-SM—275/56). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752888.

From International symposium on safety codes and guides in the light of current safety issues; Vienna, Austria (29 Oct 1984).

This communication reviews the basic principles of the seismic risk analysis for nuclear installations in France practiced by the IPSN of the CEA. The presentation of each stage of the analysis includes an account of the methods used, the difficulties met, and a comparison with the recommendations of the AIEA-SG-S1. First, this paper deals with the sismotectonic analysis and with the definition of two reference earthquakes. Then, the calculation of the ground motion corresponding to the reference earthquakes is presented. A particular attention is paid to the problems of calculation of ground motion in the case of important earthquakes near active faults and to the effect of the soil on these movements. Finally, some criticisms, a description of studies undertaken at the moment and some recommendations are presented.

606 **(CEA-CONF—7843) Assessment of fission product release from the reactor containment building during severe core damage accidents in a PWR.** Fermandjian, J.; Evrard, J.M.; Generino, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jul 1984. 14p. (CONF-840701—29; DAS—119). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752889.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Fission product releases from the RCB associated with hypothetical core-melt accidents ABβ, $S_2CD\beta$ and TLBβ in a PWR-900 MWe have been performed using French computer codes (in particular, the JERICHO Code for containment response analysis and AEROSOLS/B1 for aerosol behavior in the containment) related to thermalhydraulics and fission product behavior in the primary system and in the reactor containment building.

607 **(CEA-R—5294) Improvement of seismic analysis methods for soil-building coupled systems.** Farvacque, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1984. 204p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE85752844.

It is important to take into account soil-foundation interaction for seismic analysis of nuclear plants. In the first part, a numerical method to calculate soil-equivalent springs and dashpots is developed for any soil configuration. In the second part, the behaviour of a PWR plant is studied during an earthquake. Three approaches are used: linear elastic evaluation, equivalent linear approach, and nonlinear calculation with a cyclic behaviour law.

608 **(CONF-850610—51) Tellurium precursor effects on iodine transport in a BWR accident.** Weber, C.F.; Wichner, R.P.; Hodge, S.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - GPO. File Number TI86000085.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

This study describes the increase in iodine activity released to the atmosphere during a severe accident due to the radioactive decay of tellurium precursors. It is particularly significant since several recent studies have totally ignored this phenomenon. The work involves the analysis of a loss of decay heat removal (LDHR) accident at Browns Ferry Unit 1, as part of a general effort conducted by the Severe Accident Sequence Analysis Program at ORNL with full cooperation from the Tennessee Valley Authority. 6 refs., 2 tabs.

609 **(CONF-851019—2) Source-term evaluations from recent core-melt experiments.** Parker, G.W.; Creek, G.E.; Sutton, A.L. Jr. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01 - GPO. File Number TI86001345.

From International symposium on source term evaluation for accident conditions; Columbus, OH, USA (28 Oct 1985).

Predicted consequences of hypothetical severe reactor accidents resulting in core meltdown appear to be too conservatively projected because of the simplistic concepts often assumed for the intricate and highly variable phenomena involved. Recent demonstration work on a modest scale (1-kg) has already revealed significant variations in the mode and temperature for clad failure, in the rates of formation of zirconium alloys, in the nature of the UO_2-ZrO_2 eutectic mixtures, and in aerosol generation rates. The current series of core-melt demonstration experiments (at the 10-kg scale) seem to confirm that an increase in size of the meltdown mass will lead to an even further reduction in the amount of vaporized components. Source terms that are based on older release evaluations could be up to an order of magnitude too large. 6 refs., 6 figs., 2 tabs.

610 **(DOE/ET/34032—1) Super-Ramp Project. Final report.** Djurle, S. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Jun 1985. Contract FG06-80ET34032. 210p. NTIS (US Sales Only), PC A10/MF A01; 1; GPO Dep. File Number DE86000224.

The pellet clad interaction (PCI) failure propensity of typical LWR test fuel rods was studied under the STUDSVIK SUPER-RAMP Project by power ramp testing in the R2 test reactor of rods irradiated to higher burnup levels than tested earlier, thus expanding the existing data base. A total of 44 well-characterized fuel rods were tested: 28 rods within a PWR subprogram after base irradiation in the Obrigheim and BR3 power reactors, and 16 rods within a BWR subprogram after base irradiation in the Wuergassen and Monticello power reactors. The burnup levels ranged from 35 to 45 MWd/kg U for the PWR fuel and from 28 to 38 MWd/kg U for the BWR fuel.

611 **(EGG-RST—6956) Review and critique of April 10, 1985 exercise at the new NRC Operations Center.** Laats, E.T.; Charlton, T.R.; Bryan, G.R.; Beelman, R.J.; Bray, M.A.; Bethke, G.A.; King, M.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1985. Contract AC07-76ID01570. 23p. NTIS, PC A02/MF A01 - GPO. File Number TI85017488.

An emergency preparedness training exercise was conducted. Objectives of the exercise addressed how well the new Operations Center was utilized when responding to an incident at a nuclear power plant. The simulated accident portrayed a small (~75 gpm) leak from the Turkey Point Unit 3 primary coolant system, that led to radionuclide release that exceeded EPA guidelines at the site boundary. The Operation Center response was led by NRC Chairman Nunzio J. Palladino and the roles of the simulated power plant and other outside organizations were jointly portrayed by EG & G Idaho, COMEX Corporation and the NRC's Office of Inspection and Enforcement. Overall, the exercise was successful. The new Operations Center facility provided capabilities and services never before available, which significantly aided the performance of the Operations Center staff. The various teams that manned the Center performed credibly. Substantial improvement in team performance was noted over the past several exercises.

612 (EPRI-NP—4113-SR, pp 21.1-21.12) **TREAT light water reactor source term experiments program.** Herceg, J.E.; Blomquist, C.A.; Chung, K.S.; Dunn, P.F.; Johnson, C.E.; Kraft, D.A.; Schlenger, B.J.; Shaftman, D.H.; Simms, R. (Argonne National Lab., IL). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Four experiments are being conducted in the TREAT facility to investigate the behavior of fission products released from typical LWR fuel overheated to the point of catastrophic cladding degradation. Heatup and steam flow transients are used that simulate the conditions expected in operating power reactors undergoing various types of hypothetical severe accidents. The experiments are integral in nature and are aimed at the physicochemical characterization, near the point of origin, of the biologically important volatile fission products released early in such accidents. Detailed program objectives are discussed, a test matrix is presented, and the test apparatus is described. Pretest analysis and preliminary results are reported for the first test.

613 (EPRI-NP—4113-SR, pp 22.1-22.15) **Fission product behavior during the first two PBF severe fuel damage tests.** Osetek, D.J.; Cronenberg, A.W.; Hobbins, R.R.; Vinjamuri, K. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The results of the first two severe fuel damage tests performed in the Power Burst Facility are assessed in terms of fission product release and chemical behavior. On-line gamma spectroscopy and grab-sample data indicate limited release during solid-phase fuel heatup. Analysis indicates that the fuel morphology conditions for the trace-irradiated fuel employed in these two tests limit initial release. Only upon high temperature fuel restructuring and liquefaction is significant release indicated. Chemical equilibrium predictions, based on steam oxidation or reduction conditions, indicate I to be the primary iodine species during transport in the steam environment of the first test and CsI to be the primary species during

transport in the hydrogen environment of the second test. However, the higher steam flow rate conditions of the first test transported the released iodine through the sample system; whereas, low-hydrogen flow rate of the second test apparently allowed the vast majority of iodine-bearing compounds to plateout during transport.

614 (EPRI-NP—4113-SR, pp 23.1-23.13) **Characterization of solid debris transported in the coolant during the first two severe fuel damage tests.** Vinjamuri, K.; Osetek, D.J.; Hobbins, R.R.; Doyle, T.E. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

This paper presents the results of the characterization of solid debris collected from the coolant during the Severe Fuel Damage Scoping Test and the Severe Fuel Damage Test 1-1 conducted by EG & G Idaho, Inc., at the Idaho National Engineering Laboratory. A variety of analytical techniques was used to characterize the debris samples. Fission product release fractions and particle size distributions were measured, and the probable chemical forms in the debris were identified.

615 (EPRI-NP—4113-SR, pp 24.1-24.8) **Radionuclide deposition in the PBF steam vent line after the first two severe fuel damage tests.** Akers, D.W.; Koeppen, L.D.; McIssac, C.V.; Simpson, O.D. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Following the first two PBF Severe Fuel Damage Tests, measurable quantities of fission products remained irreversibly deposited (i.e., to water flushes) on the inside surface of the effluent steam line. The gamma spectral measurements of these deposits are presented with an analysis that describes the quantities and distribution of fission products associated with the deposits. The deposition profile along the steam line of various fission-product isotopes is presented.

616 (EPRI-NP—4113-SR, pp 25.1-25.14) **RAFT: a computer model for formation and transport of fission product aerosols in LWR primary systems.** Im, K.H.; Ahluwalia, R.K.; Chuang, C.F. (Argonne National Lab., IL). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

A computer model RAFT (Reactor Aerosol Formation and Transport) has been developed to predict the size distribution and composition of the particles (aerosols) formed from condensation of the fission-product and control rod material vapors released in LWR accidents. The underlying theory of RAFT considers the processes of homogeneous and heterogeneous nucleation, aerosol agglomeration, and aerosol and vapor deposition, in conjunction with the equilibrium chemistry of the Cs-I-Te-O-H-Ag-In-Cd-inert gas system. Calculations using RAFT show that under most accident conditions, the particle size spectrum is determined primarily by the competition between the homogeneous and heterogeneous nucleation mechanisms rather than the agglomeration mechanism, and that direct vapor deposition on structural surfaces is an important mechanism for the scavenging of fission product vapors.

617 (EPRI-NP—4113-SR, pp 26.1-26.14) **Aerosol behavior in a simulated rod bundle.** Roberts, D.L.; Kiang, R.L.; Witham, C.L.; Singh, A. (SRI International, Menlo Park, CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Measurements have been made of the deposition of concentrated aerosols in vertical flow through a small rod bundle simulating the core section of a nuclear reactor. The rod bundle was suspended in a 15-cm ID Plexiglas cylinder into which zinc or zinc oxide aerosols were delivered in concentrations ranging from 44 g/m^3 to 2930 g/m^3. The main objective of the study was to investigate the extent to which concentrated aerosols obey simple theories that apply to dilute aerosols and to provide visual, qualitative evaluation of the major physical phenomena governing particle deposition of concentrated aerosols in the core of a nuclear reactor. The rod bundle consisted of 97 rods, 7.9-mm OD and approximately 45-cm long, supported by a square pitch wire screen. The rods blocked 26% of the open area of the Plexiglas cylinder. Zinc and zinc oxide aerosols were injected into the apparatus through a tapered cone. These dusts had nearly log-normal size distributions with mass median (aerodynamic) diameters of 10.2 μm and 0.5 μm and geometric standard deviations of 1.6 and 1.8, respectively. For each dust, the core deposition model was tested at three gas flow rates. The authors observed that 39% to 98% of the particulate matter was retained within the rod bundle even though the flow velocities far exceeded the settling velocities of the particles involved. The deposition process was a dynamic one with continued buildup of particles on the rods followed by the slumping of clumps of particles to the floor of the apparatus.

618 (EPRI-NP—4113-SR, pp 27.1-27.12) **Chemical aspects of fission product transport in the primary circuit of a light water reactor.** Bowsher, B.R.; Dickinson, S.; Nichols, A.L.; Ogden, J.S.; Potter, P.E. (UKAEA, Dorchester, England). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The transport and deposition of fission products in the primary circuit of a light water reactor are of fundamental importance in assessing the consequences of severe accidents. Recent experimental studies have concentrated upon the behavior of simulant fission product species such as cesium iodide, cesium hydroxide and tellurium, in terms of their vapor deposition characteristics onto metals representative of primary circuit materials. An induction furnace has been used to generate high density/structural materials aerosols for subsequent analysis, and similar equipment has been incorporated into a glove-box to study lightly-irradiated UO_2 clad in Zircaloy. Analytical techniques are being developed to assist in the identification of fission product chemical species released from the fuel at temperatures from 1000 to 2500°C. Matrix isolation-infrared spectroscopy has been used to identify species in the vapor phase, and specific data using this technique are reported.

619 (EPRI-NP—4113-SR, pp 28.1-28.12) **Theoretical studies of primary system retention in PWR severe accidents.** Butland, A.T.D.; Haller, J.P.; Johns, N.A.; Roberts, G.J.; Williams, D.A. (UKAEA, Dorchester, England). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

This paper describes theoretical studies of primary system radionuclide retention in the Surry-1 PWR similar to recent US work. Two hypothetical severe accidents are examined, one involving a large break in the hot leg and the other a small break in the cold leg. The reference calculations described have been performed with computer programs obtained from the USA, after some limited modification and some re-evaluation of plant input data. The effects of improved modelling are then examined, including the treatment of hydrogen in the core exit gas and the effect of fission product heating in the primary circuit. Some areas of data and modelling uncertainty are also examined.

620 (EPRI-NP—4113-SR, pp 29.1-29.18) **Importance of pools, sprays, and ice beds in fission product retention in containment.** Moody, F.J. (General Electric Co.). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The retention of fission products, which may become airborne during a postulated severe accident, is an important consideration in risk assessment of nuclear plants. Both natural processes

and engineered safety features are characterized by mechanisms which remove and retain fission products. Theoretical and empirical formulations have been developed which show substantial fission product retention by pressure suppression pools, containment sprays, and ice bed condensers. Ice bed data is minimal, and more experiments are necessary for retention model verification. Theoretical trends for pool and spray retention have been verified by available data, but a more extensive data base over a broader range of geometric and thermodynamic parameters would improve model evaluation and verification, and help to minimize conservatisms. This paper provides a summary of the technological state-of-the-art of fission product retention by pools, sprays, and ice beds.

621 (EPRI-NP—4113-SR, pp 30.1-30.15) **Radionuclide scrubbing in water pools - gas-liquid hydrodynamics.** Paul, D.D.; Flanigan, L.J.; Cunnane, J.C.; Cudnik, R.A.; Collier, R.P.; Oehlberg, R.N. (Battelle Columbus Labs., OH). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

During severe core damage accidents, the amount of radioactive aerosols retained in the water pools of BWR and PWR power plants is expected to be dependent on the gas-liquid hydrodynamics of the system. Experimental studies of gas-liquid hydrodynamics have been conducted to support aerosol removal experiments at Battelle Columbus and to provide data for model validation. Tests have been conducted using mixtures of condensable (superheated steam) and noncondensable (air, helium, or hydrogen) gases injected into water pools. Expressions have been developed which describe the initial vapor globule size and emission frequency at the injector outlet, the breakup of hydrodynamically unstable vapor globules, the ultimate size distribution of gas bubbles in a water pool, and the spatial variations in the bubble rise velocities as a function of injector geometry and flow conditions.

622 (EPRI-NP—4113-SR, pp 31.1-31.16) **Scrubbing of fission product aerosols in LWR water pools under severe accident conditions - experimental results.** Cunnane, J.C.; Kuhlman, M.R.; Oehlberg, R.N. (Battelle Columbus Labs., OH). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The analysis of source teams for core damage accidents requires that the accident progression, the plant thermal hydraulic response and the associated radionuclide release and transport be analyzed for the identified escape pathways. Many of the pathways currently identified for what are believed to be the risk significant sequences involve pathway segments through water pools. Specifically, transport through the BWR pressure suppression pool and the PWR quench tank represent examples of segments of the in-plant pathways for many risk significant sequences in these plants. In order to properly analyze the fission product transport for these sequences, it is therefore necessary to describe the effect of these water pools on the steam/non-condensible gas mixtures and associated entrained radionuclides. Historically, it has been assumed that the major effect of water pools on the entrained aerosols is to attenuate the airborne radionuclide inventory. This attenuation is usually expressed quantitatively as the decontamination factor (DF) which is defined as the ratio of the mass injected to the mass which escapes from the surface of the pool. Several codes have been developed which are designed to analyze pool scrubbing DF's in severe core damage accident analysis. This paper describes Phase I of the experimental pool scrubbing work that is being conducted in conjunction with the development and validation of the SUPRA code.

623 (EPRI-NP—4113-SR, pp 32.1-32.17) **Aspects of modeling fission product scrubbing in suppression pools.** Moody, F.J.; Salamah, S.; Townsend, H.E. (General Electric Co., San Jose, CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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Theoretical predictions have shown substantial fission product retention by the discharge of carrier gas into a pressure suppression pool. Additional experimental data is becoming available for further verification of pool hydrodynamics and fission product scrubbing models in bubbling. However, parameters like gas volume rate, discharge configuration, pool depth, and aerosol particle size have broad ranges. Therefore, it is appropriate to correlate and present the available data from various experiments in terms of nondimensional groups, so that models can be evaluated for extensive parameter ranges. This study employs a normalization of equations governing the pool hydrodynamics and fission particle scrubbing with which experimental data correlation is expected. Sample correlations of available data are included.

624 (EPRI-NP—4113-SR, pp 33.1-33.20) **Evaluation of the contact time for pool scrubbing.** Amos, C.N. (General Electric Co., San Jose, CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

In the highly improbable event of severe accident in a Boiling Water Reactor (BWR), fission product aerosols may be released from the fuel. To accurately model the retention of these aerosols in BWR suppression pools, an evaluation of the contact time between the pool water, and rising gas bubbles which contain them, is required. A semiempirical model for the average gas-water contact time has been developed. Previous models for two-phase buoyant plumes have been developed in connection with the evaluation of hydrodynamic loads for undersea oil well blowouts. The current model represents an improvement on previous models. A mechanistic model for the evolution of the two-phase plume close to the injection point, has been incorporated. In addition, a simplified correlation for the entrainment of pool water and the dissipation of the plume momentum, as a result of turbulence, is proposed. Application of the model involves the solution of the two-phase conservation equations averaged over the plume cross-section. Plume rise velocity predictions are typically within 15% of the available data.

625 (EPRI-NP—4113-SR, pp 34.1-34.19) **Scrubbing of radionuclide aerosols in water pools.** Wassel, A.T.; Hoseyni, M.S.; Farr, J.L. Jr.; Oehlberg, R.N. (Science Applications, Inc., Hermosa Beach, CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

An engineering model is developed for predicting the removal of aerosol fission products from steam-noncondensable gas mixtures rising through water pools. The pool is divided into a gas injection zone, a bubble-swarm rise zone and a pool surface zone. The mathematical model is composed of a quasi-steady one dimensional formulation for the gas phase, and a time dependent, well-stirred formulation for both the liquid phase in the pool and the gas phase in the compartment above the pool. The developed computer code Suppression Pool Retention Analysis (SUPRA) incorporating the formulated mathematical models is described. Results of parametric calculations are given, which examine the effect of key inlet and pool parameters on aerosol scrubbing. Validation calculations are provided, where the predictions of the SUPRA code are compared against hydrodynamics and aerosol scrubbing experimental data.

626 (EPRI-NP—4113-SR, pp 35.1-35.13) **Particle retention in PWR ice compartments.** Owczarski, P.C. (Pacific Northwest Labs., Richland, WA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC06-76RL01830.

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Computer code ICEDF has been written to improve understanding of particle retention in PWR ice compartments, and to help plan experimental tests to validate retention models. ICEDF models the following mechanisms for particle capture: sedimentation, Brownian diffusion, impaction/interception, thermophoresis,

diffusiophoresis, and turbulent deposition. Also modeled are detailed gas phase thermodynamics, heat transfer, and aerosol descriptions, including particle/droplet growth in supersaturated atmospheres. This paper describes a sensitivity study of parameters (inlet particle size distribution and mass loading, inlet gas temperature and steam fraction, compartment parameters, ice availability and gas flow rates) on the relative importance of the particle capture mechanisms.

627 (EPRI-NP—4113-SR, pp 36.1-36.20) **Chemistry of fission products for accident analysis.** Potter, P.E. (Atomic Energy Research Establishment, Harwell, England). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Current knowledge concerning the chemical state of the fission product elements during the development of accidents in water reactor systems is reviewed in this paper. The fission product elements which have been considered are Cs, I, Te, Sr and Ba but aspects of the behavior of Mo, Ru and the lanthanides are also discussed. Some features of the reactions of the various species of these elements with other components of the reactor systems are described. The importance of having an adequate knowledge of thermodynamic data and phase equilibria of relatively simple systems in order to interpret experimental observations on complex multi-component systems is stressed.

628 (EPRI-NP—4113-SR, pp 37.1-37.10) **Chemical reactions of CsOH, CsI and Te vapors with oxidizing reactor materials.** Sallach, R.A.; Elrick, R.M. (Sandia National Labs., Albuquerque, NM). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC04-76DP00789.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The status of the High Temperature Fission Product Chemistry Program at Sandia is reviewed. Major findings are: (1) The interaction of CsOH vapor with 304 stainless steel in steam results in retention of cesium in the inner oxide layer. Microprobe analyses show a strong correlation between Cs and Si and indicate the formation of $Cs_2Si_4O_9$. (2) When CsI vapor is contacted with this alloy in steam there is little retention of Cs. (3) The interaction of Te vapor in steam with Inconel-600 at 800 C results in retention of Te. With 304 SS no Te was detected on the oxide surface for T > 800 C; at 700 C there was retention of Te. Microprobe analyses indicate the formation of a nickel telluride on both alloys. (4) Thermodynamic calculations indicate the reaction of CsOH vapor but not CsI vapor with boric acid vapors. Release of iodine, observed experimentally, may result from reaction of CsI vapor with molten B_2O_3.

629 (EPRI-NP—4113-SR, pp 39.1-39.13) **Characterization and chemistry of fission products released from LWR fuel under accident conditions.** Norwood, K.S.; Collins, J.L.; Osborne, M.F.; Lorenz, R.A.; Wichner, R.P. (Oak Ridge National Lab., TN). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC05-84OR21400.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Segments from commercial LWR fuel rods have been tested at temperatures between 1400 and 2000°C in a flowing steam-helium atmosphere to simulate severe accident conditions. The primary goals of the tests were to determine the rate of fission product release and to characterize the chemical behavior. This paper is concerned primarily with the identification and chemical behavior of the released fission products with emphasis on antimony, cesium, iodine, and silver. The iodine appeared to behave primarily as cesium iodide and the antimony and silver as elements, while cesium behavior was much more complex.

630 (EPRI-NP—4113-SR, pp 40.1-40.9) **Mass spectrometric study of the release of volatile fission products from irradiated LWR fuel.** Johnson, I.; Steidl, D.V.; Johnson, C.E. (Argonne National Lab., IL). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The chemical form and rate of release of volatile fission products (i.e., Xe, Kr, Cs, Te, and I) effused from a section of an irradiated LWR fuel pin are being studied using quadrupole mass spectrometry. The released volatile fission products must effuse through a hole drilled in the cladding to reach the ionizer of the mass spectrometer. Experiments to a temperature of 1450°C have identified krypton, xenon, cesium, tellurium, and atomic iodine (very weak signal) as the species released from the fuel. The source of the atomic iodine, i.e., dissociation of cesium iodide or dissociation of molecular iodine, has yet to be resolved. The observed rate of release of xenon is several orders of magnitude lower than previously reported. In complimentary experiments on nonradioactive material, the reaction of tellurium with the zircaloy cladding was found to hinder its release. Above 1200°C, gaseous SnTe was observed; its formation is attributed to reaction of the tin (in the cladding) with $ZrTe_2$.

631 (EPRI-NP—4113-SR, pp 41.1-41.13) **Iodine aqueous chemistry under reactor accident conditions.** Paquette, J.; Ford, B.L.; Wren, J.C. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The low volatility of iodine following the Three Mile Island-II accident has stimulated considerable interest in iodine aqueous chemistry. In this paper, we discuss the thermodynamics of the iodine/water system, the rate of disproportionation of iodine in solution, and the formation of organic iodides. A thermodynamic analysis of the iodine/water system showed that the oxidation potential is the single most important factor controlling the formation of potentially volatile iodine species at equilibrium. The time to reach equilibrium depends on the rate of disproportionation of iodine to I_2 and IO_3^-. We found the disproportionation to be second order in HOI over the pH range from 3 to 14 and to be catalyzed by phosphate ions. Raman spectroscopy was used to identify the reaction intermediates. Iodine solutions react rapidly with organic material to produce organic iodides in solution. The authors have examined the reaction of iodine with phenol to form iodophenol, and of iodine with 2-propanol to form iodoform.

632 (EPRI-NP—4113-SR, pp 42.1-42.13) **Volatility of HOI.** Wren, D.J.; Sanipelli, G. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The volatility of HOI has been measured using a mass spectrometer to analyze the gas phase above an aqueous solution. The HOI in solution was generated continuously in a flow reactor that combined I^- and OCl^- solutions. The analysis has resulted in a lower limit of 6×10^3 $mol.dm^{-3}.atm^{-1}$ for the equilibrium constant for the reaction $HOI(g) \rightleftharpoons HOI(aq)$. This value is a factor of 30 greater than the best previous estimate. This new limit for HOI volatility results in higher total iodine partition coefficients, particularly for solutions with pH > 8. The upper limit for the equilibrium constant is consistent with essentially zero volatility for HOI. The effect of HOI volatility on total iodine volatility is briefly discussed as a function of solution chemistry and kinetics.

633 (EPRI-NP—4113-SR, pp 43.1-43.11) **Aqueous chemistry of iodine.** Toth, L.M.; Pannell, K.D.; Kirkland, O.L. (Oak Ridge National Lab., TN). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC05-84OR21400.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The chemistry of iodine has been examined in aqueous solutions of pH 6 to 10 containing 2500 ppm boron as H_3BO_3 at (temperatures up to 150°C) using absorption spectrophotometry to identify and monitor the iodine species present. Kinetic rate constants for the disproportionation of the HOI intermediate, $3HOI = IO_3^- + 2I^- + 3H^+$, have been measured as a function of pH even though no direct spectral evidence for HOI itself has been observed. An HOI partition coefficient $> 10^4$ has been estimated; results of ionic strength tests are consistent with HOI being present as an uncharged triatomic species in solution. Redox and radiation effects on the aqueous iodine chemistry have also been described.

634 (EPRI-NP—4113-SR, pp 44.1-44.14) **Iodine volatility.** Beahm, E.C.; Shockley, W.E. (Oak Ridge National Lab., TN). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC05-84OR21400.

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The ultimate aim of this program is to couple experimental aqueous iodine volatilities to a fission product release model. Iodine partition coefficients for inorganic iodine have been measured during hydrolysis and radiolysis. The hydrolysis experiments have illustrated the importance of reaction time on iodine volatility. However, radiolysis effects can override hydrolysis in determining iodine volatility. In addition, silver metal in radiolysis samples can react to form silver iodide accompanied by a decrease in iodine volatility. The authors are now in the process of coupling experimental data to an iodine transport and release model that was developed in the Federal Republic of Germany.

635 (EPRI-NP—4113-SR, pp 45.1-45.19) **Review of DEMONA results.** Haschke, D.; Hosemann, J.P.; Schock, W.; Ruhmann, H. (Swiss Federal Institute for Reactor Research, Wuerenlingen). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The purpose of the DEMONA experiments is to demonstrate the aerosol decay and retention in the containment of a KWU-design 1300 MWe PWR. The DEMONA test matrix is set up to investigate aerosol behavior under various stationary and transient thermodynamic conditions typical of core-melt scenarios and to demonstrate the proper interfacing between the containment thermodynamic and aerosol physics codes. Furthermore, experiments are planned upon which a comparison of single compartment and multicompartment calculations of aerosol decay will be made. Preliminary tests were carried out to demonstrate sufficient leak tightness of the Battelle-Frankfurt containment for pressures of up to 3 bar. Aerosol generation will be achieved by vaporization of metal powders in a plasma torch and subsequent oxidation. Extensive development work was necessary to optimize oxidation chamber geometry and cooling in order to assure reliable and efficient aerosol generation. A large scale dry test, which will demonstrate the capability of generating aerosols of the desired initial density of approximately 10 g/m³ in a dry containment atmosphere is underway. Full aerosol instrumentation is available for this test to measure both spacial and temporal distribution of total aerosol density as well as size distribution. Following the dry test, the first full-scale aerosol test in a wet atmosphere will be performed.

636 (EPRI-NP—4113-SR, pp 46.1-46.11) **Generation and properties of highly concentrated metal oxide aerosols in a steam atmosphere.** Mercier, O.; Schoeck, W. (Swiss Federal Institute for Reactor Research, Wuerenlingen). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

For a large scale aerosol behavior experiment, generators are being constructed which will produce 8 kg of metal oxide within one hour into a 640 m³ vessel containing a hot pressurized steam-air-mixture. Preliminary tests have been carried out with a 10 kW plasma gun mounted in a 1 m³ test vessel. Fe and Sn powders were vaporized and oxidized in the gun, and condensed to aerosols with primary particles in the size range of 0.1 to 0.3 μm. Aerosol production rates of > 10 g/min have been measured; the resulting high mass concentrations cause fast coagulation and removal of particles in the small volume. No influence of the composition of the vessel atmosphere on aerosol production rates was observed. The subsequent aerosol behavior, however, is strongly enhanced by the presence of steam.

637 (EPRI-NP—4113-SR, pp 47.1-47.11) **LWR aerosol containment experiments (LACE) program and initial test results.** Muhlestein, L.D.; Hilliard, R.K.; Bloom, G.R.; McCormack, J.D.; Rahn, F.J. (Westinghouse Hanford Co., Richland, WA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The LWR aerosol containment experiments (LACE) program is described. The LACE program is being performed at the Hanford Engineering Development Laboratory (operated by Westinghouse Hanford Company) and the initial tests are sponsored by EPRI. The objectives of the LACE program are: (1) to demonstrate, at large-scale, inherent radioactive aerosol retention behavior for postulated high consequence LWR accident situations; and (2) to provide a data base to be used for aerosol behavior and thermal hydraulic computer code validation. Test results from the first phase of the LACE program are presented and discussed. Three large-scale scoping tests, simulating a containment bypass (event V) accident sequence, demonstrated the extent of agglomeration and deposition of aerosols occurring in the pipe pathway and vented auxiliary building under realistic accident conditions. Parameters varied during the scoping tests were aerosol type and steam condensation.

638 (EPRI-NP—4113-SR, pp 48.1-48.11) **FIPLOC-calculations on the CSE Experiments A-5 and A-11.** Weber, G.; Jahn, H. (Gesellschaft fuer Reaktorsicherheit Forschungsgelaende, Garching, West Germany). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Transport and deposition of fission products depend on containment geometry and accident specific conditions. FIPLOC is a multicompartment containment code. Subcompartmentalization and post-accident atmosphere conditions are described by the lumped parameter technique. Transport and deposition of gas components and aerosols are calculated simultaneously. The code was applied on two CSE experiments. Simulation includes: (1) vessel heat up by steam, (2) injection of cesium aerosol, methyl iodide, auxiliary steam, and (3) system behavior, natural transport and fission product deposition. The local concentrations observed and the significant differences of the two experiments are explained by FIPLOC analysis.

639 (EPRI-NP—4113-SR, pp 49.1-49.13) **Auxiliary building thermal-hydraulic conditions relevant to radionuclide retention for the interfacing-systems LOCA.** Slaughterbeck, D.C.; Davis, P.R.; Rahn, F.A. (Intermountain Technologies, Inc., Idaho Falls, ID). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Following a postulated core melt accident in a light-water nuclear power reactor, thermodynamic conditions in regions containing radioactive materials released from the core could markedly influence retention of those materials. Usually the regions in question are the containment building and suppression systems. However, in postulated accidents in which the primary reactor system fluid bursts into an interfacing system, such as the low pressure injection system, the effluent could bypass containment and be released in the auxiliary safeguards, or other support buildings. In this paper, the thermal-hydraulic characteristics in the auxiliary building, and their significance on aerosol retention, are reported for an

interfacing-systems LOCA. The work is sponsored by the Electric Power Research Institute.

640 (EPRI-NP—4113-SR, pp 50.1-50.15) **Computer code (WETBERAN) for wet sequence behavior of radioactive nuclides in LWR plant at accident conditions.** Shimooke, T.; Kobayashi, K.; Sato, S. (Institute of Nuclear Safety, Tokyo, Japan). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The WETBERAN code has been developed to simulate the isotopic- and time-dependent behaviors of fission products (FP) which leak through the multiple paths of liquid and gas flows within LWR plant under accident conditions. In this code, emphasis is put on the phenomena pertinent to the presence of water. The TMI, SL-1 and Ginna accidents were analyzed to show the code capability. The TMI 40 day analysis gave detailed information of FP behaviors, both leaking from and remaining in the plant, and proved effectiveness of the network model describing the multiple leakage paths. The SL-1 analysis was made to study halogen reduction by water, which cannot be taken into account by CORRAL. The Ginna analysis was to check the iodine transport by droplets usually generated by primary water flashing at SG tube rupture.

641 (EPRI-NP—4113-SR, pp 51.1-51.12) **Aerosol behavior in the reactor containment building during severe accident.** Berthion, Y.; Lhiaubet, G.; Gauvain, J. (CEA Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Thermohydraulic behavior inside a PWR containment during severe accident depends on decay heat transferred to the sump water by aerosol gravitational settling and deposition. Conversely, aerosol behavior depends on thermal hydraulic conditions, especially atmosphere moisture for soluble aerosol CsI, and CsOH. Therefore, a small iterative procedure between thermo-hydraulic and aerosol calculations has been performed in order to evaluate the importance of this coupling between the two phenomena. In this paper, it is shown that with this procedure and using our codes JERICHO, RICOCHET and AEROSOLS/B1, the steam condensation on aerosols is an important phenomenon for a correct estimation of the attenuation factor of the suspended mass of aerosols in the airborne of the containment. Then, a more realistic assessment is attained of the source term released by the containment.

642 (EPRI-NP—4113-SR, pp 52.1-52.17) **Modeling radionuclide behavior in LWR containments during severe accidents.** Avci, H.I.; Cunnane, J.C. (Battelle Columbus Labs., OH). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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As part of a program to develop a comprehensive package of risk assessment codes, Battelle's Columbus Laboratories assessed the phenomena that influence the behavior of radionuclides in LWR containments during severe accidents and identified models suitable for analyzing the important phenomena. This paper describes the equations identified to be suitable for calculating (1) the inventories of radionuclides that are airborne, deposited on surfaces, and contained in water pools or filters in LWR containments, and (2) the environmental release rates of the radionuclides from the LWR containments under severe accident conditions.

643 (EPRI-NP—4113-SR, pp 53.1-53.53.18) **Sensitivity study of aerosol agglomeration and deposition using the MAEROS model.** Leigh, C.D.; Helton, J.C. (Sandia National Labs., Albuquerque, NM). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC04-76DP00789.

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In support of the MELCOR program, a study of the sensitivities and uncertainties associated with MAEROS aerosol code predictions has been performed for TMLB accident conditions using Latin hypercube sampling techniques and regression analysis methods. Agglomeration and deposition in the reactor containment of two aerosol components, an in-vessel aerosol and an ex-vessel aerosol, were examined by varying the values of 24 code input parameters that defined containment geometry, containment thermal-hydraulic conditions, aerosol source characteristics, and agglomeration and deposition rate constants. Twenty aerosol size sections, spanning the size range 0.01 to 200μ, were used to develop the sensitivities and uncertainties associated with code predictions of the total suspended mass, the time to 90% deposition, and the total integrated gas borne mass density of each aerosol component. These sensitivities and uncertainties were found to depend principally on the following four input parameters: the source strength of the ex-vessel aerosol, the agglomeration shape factor, the turbulent energy dissipation rate, and the particle mass density. Decreasing the number of aerosol size sections to 15 or 10 sections did not significantly alter any calculated result; and use of only 5 sections altered results by less than 10%. Results were also unaffected by increasing the lower bound of the aerosol size distribution from 0.01 to 0.1μ or decreasing the upper bound from 200 to 50μ.

644 (EPRI-NP—4113-SR, pp 54.1-54.15) **Phenomenological uncertainties in the suspended radionuclide concentrations in containment during severe LWR accidents.** Williams, D.C.; Murata, K.K.; Tillis, J.L. (Sandia National Labs., Albuquerque, NM). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC04-76DP00789.

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CONTAIN, a code for integrated analysis of containment phenomenologies in complex LWR severe accident sequences, is being applied in a program for evaluating the uncertainties in USNRC-sponsored efforts to better define LWR accident source terms. The Surry TMLB sequence was studied in detail. Aerosol agglomeration uncertainties were found to contribute about an order of magnitude to the overall uncertainty in suspended radionuclides (almost entirely downward uncertainty; i.e., downward with respect to current base case estimates such as BMI-2104). Containment compartmentalization effects contribute substantial uncertainties in either direction, while effects due to complex multicomponent aerosol compositions contribute lesser, but still potentially significant uncertainties (mostly downward). Incomplete treatment of radionuclide decay chains can contribute factor-of-two upward uncertainties.

645 (EPRI-NP—4113-SR, pp 55.1-55.8) **Fission product behavior during the TMI-2 accident.** Tooper, F.E. (Dept. of Energy, Washington, DC). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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An overview of the TMI-2 accident analysis and fission product behavior research activities performed for the DOE will be provided. Included in the overview will be the latest results from the TMI-2 accident sequence assessment and concomitant implications related to fission product transport, deposition, and retention mechanisms for core melt dominant accident sequences. Other areas are being addressed as part of the TMI-2 accident sequence assessment such as core degradation phenomena including debris bed coolability. A summary of observations are provided.

646 (EPRI-NP—4113-SR, pp 56.1-56.11) **TMI-2 core debris analytical methods and results.** Akers, D.W.; Cook, B.A. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

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A series of six grab samples was taken from the debris bed of the TMI-2 core in early September 1983. Five of these samples

were sent to the Idaho National Engineering Laboratory for analysis. Presented is the analysis strategy for the samples, and some of the data obtained from the early stages of examination of the samples (i.e., particle size-analysis, gamma spectrometry results, and fissile/fertile material analysis).

647 (EPRI-NP—4113-SR, pp 57.1-57.11) **TMI-2 leadscrew radionuclide deposition and characterization.** Vinjamuri, K.; Akers, D.W.; Hobbins, R.R. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

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Two leadscrews, H8 and B8, from the TMI-2 reactor were examined by EG & G Idaho, Inc., at the Idaho National Engineering Laboratory. Metallography, hardness measurements, and chemical and radiological analyses were conducted on samples cut from the leadscrews. Hardness measurements and microstructure analysis suggest that (a) a significant temperature gradient existed between the portions of the leadscrews closest to the core and the portions near the top of the upper plenum, and (b) leadscrew B8 experienced a slower cooling rate than H8. Chemical analyses indicate that UO_2 and Zr were deposited on surfaces closer to the core. Radiological analyses suggest that a majority of the H8 radionuclides are insoluble in strong acid solutions. In contrast, the majority of the B8 radionuclides are soluble in strong acidic solutions. Significant radioactivity is associated with the smallest size ($\leq 0.45\mu m$) brushoff debris. The greatest activity was found close to the top of the upper plenum.

648 (EPRI-NP—4113-SR, pp 58.1) **TMI-2 radiocesium behavior.** Lorenz, R.A.; Campbell, D.O.; Malinauskas, A.P.; Collins, E.D.; Lowrie, R.S.; Culberson, O.L.; Collins, J.L. (Oak Ridge National Lab., TN). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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It is often assumed that the chemical form of fission product cesium after release from fuel in a severe LWR accident is a mixture of ~ 90% CsOH and ~ 10% CSI. Release, transport, reaction, and postaccident leaching data from TMI-2 have been examined in an effort to establish the validity of this assumption. Gas-phase transport of cesium occurs as a combination of vapor and species forming or attached to liquid - or solid aerosol particles. Chemical reactions can occur with either structures or aerosols. Results of the analysis show behavior characteristics of the assumed initial chemical forms of cesium.

649 (EPRI-NP—4113-SR, pp 59.1-59.9) **RETAIN analysis of the TMI-2 primary system.** Burns, R.D. III; Ozboya, N.M. Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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Results of TMI-2 leadscrew examinations are compared to predictions of fission product transport and deposition models. RETAIN-2B, TRAC and MIMAS were used to represent the TMI-2 RCS during the period of core uncovery, (during which time the generation of core material aerosols is expected to have occurred) the size, composition, and deposition of core aerosols on the leadscrews is in qualitative agreement with predictions, except for the discovery of an adherent, glassy layer on leadscrew surfaces, containing significant radio-cesium activity. The potential for surface interactions to prevent evaporation of deposited fission products is identified as a modeling need.

650 (EPRI-NP—4113-SR, pp 60.1-60.13) **Radionuclide distribution in TMI-2 reactor building basement liquids and solids.** Horan, J.T.; Keefer, D.G.; McIsaac, C.V. (EG & G Idaho, Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

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Large quantities of radioactive water and some core debris solids were released to the reactor building basement during the March 1979 accident at Three Mile Island Unit 2 (TMI-2). A reactor building basement sampling and analysis program is underway to support fission product mass balance and source term studies, TMI-2 accident analysis, and decontamination planning. Liquid and solid samples were collected from a variety of locations to determine the composition, quantity, and distribution of the debris and fission products released to the basement environment. Basement water sources, sample history, and sampling techniques are discussed. Fuel, radionuclide content and elemental composition of liquid and solid samples are presented. Conclusions are presented on the partitioning of fission products within liquids and solids and on the transport paths within the basement area.

651 (EPRI-NP—4113-SR, pp 61.1-61.17) **Results of surface activity and radiation field measurements made during surface decontamination experiments conducted at TMI-2.** McIsaac, C.V.; Davis, C.M.; Horan, J.T.; Keefer, D.G. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

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The loss of coolant accident at TMI-2 exposed about 22,000 square meters of concrete and metal surfaces within the reactor building to liquid and vapor-phase radionuclide contamination. During the course of the accident, floors and walls of the auxiliary fuel handling building were also contaminated. Since 1981 the decontamination of these surfaces has been conducted using water spray, strippable coating, and scabbling techniques. These decontamination studies have helped determine the distribution of radionuclides on building surfaces, and the nature of the radionuclide penetration into surface coatings. In addition, in situ radiological surveys of decontamination effectiveness were performed. This paper reviews the results of these surface decontamination studies and presents conclusions on the nature and extent of reactor building contamination as a consequence of the TMI-2 accident.

652 (EPRI-NP—4113-SR, pp 62.1-62.13) **Distribution of selected fission products that escaped the core during the accident at TMI-2.** Cox, T.E.; Jacoby, J.K.; Voilleque, P.G.; Pelletier, C.A.; Daniel, J.A. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

One consequence of the TMI-2 accident was the release of fission products from the fuel to the reactor coolant system and the subsequent transport of radioactivity to the reactor building, auxiliary building, and the environment. Post-accident measurements of radionuclide concentrations and fluid volumes have provided data on distributions in the plant. Measurement data of ^{3}H, ^{85}Kr, ^{133}Xe, and ^{90}Sr, ^{129}I and ^{131}I, and ^{137}Cs have been used to attempt to account for the total radionuclide inventories present at the time of the accident. Initial assessment showed that large fractions of all inventories were unaccounted for outside the fuel. Recent analytical results for samples of sludge, plenum scrappings, demineralizer resins, and fuel debris are used to develop more definitive accounts of these important inventories.

653 (EPRI-NP—4113-SR, pp 63.1-63.16) **Radionuclide release under specific accident conditions for the Zion plant - BMI-2104 update.** Gieseke, J.A.; Cybulskis, P.; Denning, R.S.; Kuhlman, M.R.; Chen, H.; Lee, K.W.; Silberberg, M.; Jankowski, M. (Battelle Columbus Labs., OH). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The scope of this paper is to present and discuss predictions of fission product release to the environment and the thermal hydraulic factors influencing this release for the Zion plant under assumed severe accident conditions. Two basic sequences, S_2D and TMLB' (as designated by WASH-1400 terminology), have been

considered with several different assumptions about the course of events within each sequence selected to permit illustration of sensitivities. The S_2D sequence has been treated assuming formation of a debris bed in the reactor cavity which is either coolable or not coolable to investigate the effects of this assumption on thermal hydraulic conditions in the containment. The TMLB' sequence has been considered with rapid debris bed quench or with direct concrete attack and with four different assumptions regarding containment leakage to investigate the effects of the assumptions on containment thermal hydraulic conditions and fission product release to the environment. The approach taken in this study is based on the premise that mechanistic predictions of radionuclide release and transport are possible if proper modeling is performed to represent the physical and chemical processes occurring during LWR accidents. The approach, then, represents an attempt to describe in a reasonably complete, but tractable, fashion the processes influencing radionuclide release to the environment for selected plants and accident conditions.

654 (EPRI-NP—4113-SR, pp 64.1-64.13) **Realistic assessment of radionuclide releases under accident conditions at Indian Point 3 nuclear station.** Bieniarz, P.P.; Deem, R.E.; Iyer, S.S.; Favora, J. Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

A realistic analysis of the radionuclide releases under accident conditions at the Indian Point 3 nuclear station has been performed using modified and improved versions of the computer codes MARCH 2.0, MERGE, CORSOR, TRAP-MELT, and MATADOR. Among the major improvements to these codes was the combining of MERGE, CORSOR and TRAP-MELT into a single computer code, with MERGE and CORSOR being subroutines of TRAP-MELT. In addition, fission product heating of the primary system as well as energy losses through insulation of the primary system have been included in the analysis. The removal of fission products in the containment has been analyzed by using a version of the TRAP-MELT computer code, modified for containment applications. The results of the analyses show that the primary system plays an important role in retaining fission products after their release from the core. Moreover, results indicate that fission product heating is an important phenomenon, and the energy deposited from the fission products in the primary system structures may result in the failure of the primary system prior to the reactor lower head melt-through by the molten core. Furthermore, results indicate that the fission products released from the primary system to the containment are removed from the containment atmosphere by natural processes, mainly gravitational settling, within 6 to 8 hours of the initial release. The failure of the primary system due to the fission product heating would result in the primary system depressurization prior to lower reactor head failure, and hence, will prevent the occurrence of the dispersive core expulsion from the primary system.

655 (EPRI-NP—4113-SR, pp 65.1-65.15) **Application of probability distributions for quantifying uncertainty in radionuclide source terms for Seabrook risk assessment.** Walker, D.H.; Savin, N.L. (Westinghouse Electric Corp., Jacksonville, FL). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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In some of the recent probabilistic safety assessments, discrete probability distributions (DPDs) have been developed to express, in a quantitative form, estimates of the uncertainty and conservatism in the point estimate source term values. In the DPD approach, distributed, discrete factors, which are multipliers on the point estimate values by the selected factor are made based on available data, calculations, and engineering judgment. Initial application of the DPD approach to source terms for risk analysis was based largely on engineering judgment after review of applicable data. However, in more recent applications of the DPD approach, results from an extensive review of existing experimental data and applied calculations have been factored into the estimates. Programs currently in progress, largely sponsored by NRC and EPRI, are beginning to yield significant new information upon which to base improved estimates for the magnitude of radionuclide source terms. The most extensive of the reviews of existing data for application to the DPD approach was that performed as part of the risk assessment for the proposed Sizewell B PWR. As part of the Seabrook risk study, DPD values specifically for that plant were developed based on the Sizewell approach. They represent a significant update to the Sizewell DPD values. In addition, DPD values were developed for associated release parameters which also affect the consequence calculations.

656 (EPRI-NP—4113-SR, pp 66.1-66.23) **Source term uncertainties for the Seabrook station probabilistic risk assessment.** Torri, A. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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Accident source terms are defined as a set of release categories that define the time and quantity of radionuclides released for different containment failure modes and groups of accident sequences. Best estimates of these source terms are characterized by very large uncertainties. A probabilistic risk assessment (PRA) aims to determine realistic consequences. Estimating source term uncertainties is therefore as important as estimating the source terms themselves. A systematic analysis of source term uncertainties was performed for the Seabrook PRA. Uncertainties were quantified due to in-vessel retention, ex-vessel retention, different accident sequences, accident progression phenomena, containment failure time, containment failure modes, and leak path attenuation. The cumulative effect of all sources of uncertainties resulted in a difference between best estimate release fractions and the 99% confidence level of a factor of 10 to 100. The CORRAL predicted release fractions are found to be upper bounds with a 99% confidence level or higher.

657 (EPRI-NP—4113-SR, pp 67.1-67.13) **Calculation of fission product release to the environment for some PWR core melt sequences.** Schroedl, E.; Friederichs, H.G. (Gesellschaft fuer Reaktorsicherheit (GRS)mbH, Koeln, West Germany). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Calculations of fission product release from the fuel, and for fission product transport and depletion within the containment are performed considering BIBLIS-B, a KWU-type 1300 MWe PWR. A large pipe break accident was analyzed, assuming ensued containment isolation, and failure of the emergency cooling recirculation system leading to late overpressure failure. The behavior of particulate fission products was calculated with the NAUA code taking into account the special plant design features: steel containment and surrounding annulus. A sensitivity analysis of the release to the environment reveals the influence of parameters such as primary mass release, agglomeration processes, leak rates, and geometry of the involved compartments.

658 (EPRI-NP—4113-SR, pp 68.1-68.9) **Assessment of fission product release from the reactor containment building during severe core damage accidents in a PWR.** Fermandjian, J.; Evrard, J.M.; Cenerino, G. (CEA/IPSN/DAS, Fontenay-aux-Roses, France). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The paper assess fission product releases from the reactor containment building associated with several WASH 1400 risk dominant accident scenarios by using computer models related to thermalhydraulics and fission product behavior in the primary system and in the reactor containment building. In contrast with previous publications, more severe accidents have been assumed here, supposing an early failure of containment isolation.

659 (EPRI-NP—4113-SR, pp 69.1-69.13) **Computer code development programs at JAERI on fission product behavior.** Soda, K.; Uchida, M.; Naritomi, M. (Japan Atomic Energy Research Institute, Tokaimura). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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As a part of computer code development programs on severe accident analysis, computer programs HORN and REMOVAL, are being developed for analysis of fission product release and transport in primary coolant system and containment vessel. HORN is designed to calculate fission product release and transport in primary coolant system and the code is capable of predicting chemical forms of volatile fission product in a leak path based upon equilibrium assumptions. REMOVAL is to calculate aerosol removal by natural mechanism as well as engineered safety features in containment vessel. The model includes steam condensation onto aerosol particles. Results of sensitivity analyses are presented along with description of the models used in each code.

660 (EPRI-NP—4113-SR, pp 70.1-70.11) **V sequence: an engineering viewpoint.** Drozd, A.; Elia, F.A. Jr.; Metcalf, J.E. (Stone & Webster Engineering Corp., Denver, CO). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The interfacing system LOCA is regarded as a significant contributor to risk at the Surry Nuclear Power Station, based on the WASH-1400 analysis, and, by implication, at other plants as well. A new analysis, incorporating specific engineering and arrangement features not previously considered, shows that the structure in which the postulated break occurs remains intact, and at the time of fission product release, the postulated break location would actually be submerged by drainage from the refueling water storage tank. Submergence of the break provides effective scrubbing of any fission products released at the break location. The general applicability of these conclusions is addressed.

661 (EPRI-NP—4113-SR, pp 71.1-71.13) **Effects on consequences of the high steam content in LWR accident releases: physics and preliminary results.** Spulak, R.G. Jr.; Boughton, B.A.; Williams, D.C.; Cummings, J.C.; Alpert, D.J.; Richards, C.N.; Dunn, W.E. (Sandia National Labs., Albuquerque, NM). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC04-76DP00789.

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The research has addressed the possibility that condensation of steam during the release of containment gases and aerosol particles to the atmosphere after a core-melt accident could deposit a significant fraction of the radioactive material near the plant. This paper describes the modeling of accident releases including this rainout and discusses the impact of our findings on risk predictions. Our models include details of the hydrodynamics of the flow from containment, thermodynamics of the release mixture, explicit consideration of condensation on the radioactive aerosols, turbulent agglomeration of aerosols and water droplets, buoyant plume physics, and the dispersion and deposition of drops. The authors discuss the initial and boundary conditions which lead to significant rainout.

662 (EPRI-NP—4113-SR, pp 1.1-1.24) **Overview of fission product release experiments.** Hobbins, R.R.; Johnson, C.E.; Lorenz, R.A.; Taig, A.R.; Vogel, R.C. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570;AC04-76DP00789.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Most of the current consequence analyses use NUREG-0772 correlations derived from early data. New information is now being produced and it is timely to see how the new information agrees with the NUREG-0772 correlation. This paper will briefly discuss PBF, STEP, ORNL, and ANL laboratory data. Additionally, the contribution of Sandia QUEST will be discussed. These topics will be covered in more depth in other papers at this meeting.

663 (EPRI-NP—4113-SR, pp 2.1-2.15) **Fission product release from irradiated LWR fuel under accident conditions.** Strain, R.V.; Sanecki, J.E.; Osborne, M.F. (Oak Ridge National Lab., TN). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Fission product release from irradiated LWR fuel is being studied by heating fuel rod segments in flowing steam and an inert carrier gas to simulate accident conditions. Fuels with a range of irradiation histories are being subjected to several steam flow rates over a wide range of temperatures. Fission product release during each test is measured by gamma spectroscopy and by detailed examination of the collection apparatus after the test has been completed. These release results are complemented by a detailed post test examination of samples of the fuel rod segment. Results of release measurements and fuel rod characterizations for tests at 1400 through 2000°C are presented in this paper.

664 (EPRI-NP—4113-SR, pp 3.1-3.14) **Review of the main results of the SASCHA program on fission product release under core melting conditions.** Albrecht, H.; Wild, H. (Kernforsichungszentrum, Karlsruhe, West Germany). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

In the SASCHA facility, out-of-pile experiments were carried out to study the relevant parameters influencing the fission product release and aerosol formation under LWR core melting conditions. The investigations include: (a) behavior of I and Cs during and after release from the fuel, (b) potential of AgI formation in the gas phase, (c) size distribution and chemical composition of aerosol particles, (d) influence of steam supply and degree of Zircaloy oxidation, (e) determination of fractional release rate coefficients, (f) fission product release during melt/concrete interaction, and (g) estimates of integral values for the release of radioactivity and aerosol mass from the primary system. It was found that even from these small scale experiments the integral activity release can be determined with an accuracy better than +/- 15% for specific assumptions on the primary system temperatures.

665 (EPRI-NP—4113-SR, pp 4.1-4.12) **Cs and I source terms of irradiated UO_2.** Peehs, M.; Kaspar, G.; Neeb, K.H. (Kraftwerk Union Aktiengesellschaft, Erlangen, West Germany). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The release of fission Cs and Iodine from UO_2 with a burn up $\leq$ 47 GWd/tU were determined experimentally in the temperature range between 900°C and 1800°C. The releases occur always in 2 characteristic steps: a burst release ($t \leq 60$ s) and a mainly diffusion controlled release ($t \geq 60$ s). The burst release is thermally activated and depends strongly on the surface/volume ratio and burnup. The second release step is also from Arrhenius type and is proportional to t/sup n/ with $0,5 \leq n \leq 1$. Besides diffusion processes also restructuring of fuel in the high temperature range influences this release phase.

666 (EPRI-NP—4113-SR, pp 5.1-5.14) **Release and retention phenomena in LWR degraded cores.** Taig, A.R. (Sandia National Lab., Albuquerque, NM). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC04-76DP00789.

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This paper discusses the role played by vapor pressure and gas-phase mass transfer in the release of fission products from degraded reactor cores. The implications for releases from LWR

cores in severe accidents are discussed, and simple criteria are developed to determine under what conditions gas-phase transport processes may limit release rates. Existing experimental results are reviewed to determine whether gas-phase phenomena may have influenced some of the available release data. A simplified single-channel model of a reactor core is presented which enables the limitations on release imposed by evaporation and condensation to be accounted for in a reactor accident condition. The paper concludes that, though these phenomena need not have played a limiting role in experiments to date, they could have very important effects in certain high pressure, low flow accidents. Substantial reductions in in-vessel releases compared to the predictions of some current models are possible.

667 (EPRI-NP—4113-SR, pp 6.1-6.14) **Estimate of fission product release during core melting.** Yu, W.S.; Ludewig, H. (Brookhaven National Lab., Upton, NY). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The model developed in the Reactor Safety Study (RSS) to describe fission product release from a damaged core has been used in several subsequent probabilistic risk assessments. An alternative model for fission product release was suggested in NUREG-0772. This model is based on more extensive data and is more mechanistic; as a result, the quantity of fission products released is a function of the accident sequence. In this paper the authors present the application of this alternative model to three postulated core meltdown accident sequences in a boiling water reactor. The differences between the fission product release fractions for the various sequences and between these results and the RSS model is presented. In addition, the CORSOR code was also applied to these sequences and comparisons were made between the results of our model and the CORSOR calculations.

668 (EPRI-NP—4113-SR, pp 7.1-7.14) **Transient fission gas release during direct electrical heating experiments.** Fenske, G.R.; Emerson, J.E.; Savoie, F.E. (Argonne National Lab., IL). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

An out-of-reactor direct electrical heating technique was used to measure the noble gas release behavior of irradiated mixed-oxide fuel subjected to thermal transients prototypical of hypothetical loss-of-flow events in fast reactors such as the Clinch River Breeder Reactor. The results of tests with average heating rates ranging from ~100 to ~2000°C/s indicate that microcracking- and diffusion-controlled processes govern the release of the noble gases from fuel pellets once they are released from intragranular regions. The tests also demonstrated that the process (microcracking or diffusion-controlled processes) that dominates the release is dependent on the retained gas content, the presence of a radial restraint imposed by the cladding, and the fuel enthalpy.

669 (EPRI-NP—4113-SR, pp 8.1-8.16) **Review of issues and associated R & D relative to containment integrity and radionuclide behavior.** Walker, D.H.; Millunzi, A.C.; Brockett, G.F.; Davis, P.R. (Westinghouse Electric Corp.). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

This paper presents the results of a DOE-sponsored program to examine technical issues and related R & D for improved assurance of containment of radionuclides during severe accidents in nuclear power reactors. The program involved identifying and priority ranking the relevant issues associated with radionuclide release and transport as well as containment integrity during severe accidents. Related R & D programs were also identified and evaluated to determine which issues may not be adequately covered by these R & D programs. Those issues not adequately covered were priority ranked as the basis for further consideration.

670 (EPRI-NP—4113-SR, pp 9.1-9.13) **Implications of source term research for ex-plant consequence modeling.** Kaiser, G.D. (NUS Corp., Gaithersburg, MD). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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Current fission product source term research has important implications for several areas of ex-plant consequence modeling, including predictions of (a) the public risk of early fatality, early injury, and latent cancer fatality; (b) individual risk of early and latent cancer fatality and comparison with safety goals; (c) deposition of radioactive materials and subsequent contamination of land; (d) provision of technical input to considerations of emergency response and planning. The sensitivity of the above to source term characteristics (e.g., source term magnitudes, timing of the release, and duration of the release) will be investigated. Significant issues will be discussed in terms of current source term research; e.g., whether such research yet demonstrates that early fatalities can be ruled out after a reactor accident.

671 (EPRI-NP—4113-SR, pp 10.1-10.6) **Worst case reactor accidents: a paradox.** Acharya, S.; Pasedag, W.; Hulman, J.; Silberberg, M. (Nuclear Regulatory Commission, Washington, DC). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The preliminary results from the application of improved source term methodology indicate a diversity of results for plants of different design, and for different accident sequences postulated for the same plant. While significant reductions from previous estimates are calculated with the new methodology for some accident scenarios, the same methodology predicts release magnitudes of minor difference from those produced with earlier methods for other accident sequences and plants. This divergence of calculated results precludes the adoption of a worst case as a meaningful characterization of severe accident consequences. This situation reinforces the need to consider the consequences of severe accidents only in light of their probability, even in those applications outside the traditional risk assessment process, and may necessitate re-consideration of a probability threshold for extremely low probability events. A practical approach to such a threshold value is discussed, based on NRC's experience with severe accident considerations in environmental impact statements.

672 (EPRI-NP—4113-SR, pp 11.1-11.16) **Effect of source term composition on offsite doses.** Karahalios, P.; Gardner, R. (Stone & Webster Engineering Corp., Boston, MA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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The development of new realistic accident source terms has identified the need to establish a basis for comparing the impact of such source terms. This paper attempts to develop a generalized basis of comparison by investigating contributions to offsite acute whole body doses from each group of radionuclides being released to the atmosphere, using CRAC2. The paper also investigates the effect of important parameters such as regional meteorology, sheltering, and duration of release. Finally, the paper focuses on significant changes in the relative importance of individual radionuclide groups in PWR2, SST1, and a revision of the Stone & Webster proposed interim source term.

673 (EPRI-NP—4113-SR, pp 12.1-12.13) **Fission product release from artificially perforated fuel rods operating in a test reactor loop.** Davies, J.H. (General Electric Co., San Jose, CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

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Artificially perforated zirconium barrier fuel rods were irradiated at a power of 35 kW/m to burnups in excess of 3 MWd/kg U. Fission product release, monitored during irradiation, is correlated with test loop pressure changes and reactor power changes. Release mechanisms from operating defective fuel are discussed in terms of reduced fuel and gap conductances. Zirconium barrier fuel, like conventional fuel, can be successfully operated for extended periods with cladding perforations.

674 (EPRI-NP—4113-SR, pp 13.1-13.14) **Detection of defective fuel in an operating CANDU 600 MW(e) reactor.** Manzer, A.M.; Sancton, R.W. (Atomic Energy of Canada Ltd.). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

CANDU 600 MW(e) reactors are monitored continuously for defective fuel which can be located and removed at full power if necessary. Methods of analyzing activity measurements can be used to prepare operational guidelines to keep the reactor system clean while avoiding premature discharge of fuel. Removal should occur before defects begin to contaminate the heat transport system by releasing UO_2 to the coolant. In this paper, the authors describe how to analyze the coolant activity concentrations of delayed neutron emitting isotopes, to predict when the UO_2 release occurs. Operating data from the Point Lepreau Nuclear Generating Station were used to support the predictive methods.

675 (EPRI-NP—4113-SR, pp 14.1-14.12) **Release of short-lived fission products from operating UO_2 fuel under oxidizing conditions.** Hunt, C.E.L.; Lipsett, J.J.; Hastings, I.J. (Chalk River Nuclear Labs., Ontario). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The authors have examined, using a sweep gas technique, the effects of oxidation on the release of short-lived fission products from UO_2 fuel elements (similar to CANDU reactor fuels) which defected, and from intact elements where water was deliberately added via the sweep gas. In both types of experiment, the short-lived fission products showed qualitatively similar behavior. On initiating oxidation, there was a transient period during which the release of fission products depended on their inventory in the UO_2. After the transient, diffusion-controlled steady state release resumed. Fission gases with short-lived precursors were released at about twice the pretransient rate while those with long-lived precursors (Xe-133, -135m, -135) were released at about 4.5 times the pretransient rate. These results suggest that, under oxidizing conditions, the effective diffusion coefficient for the iodines increases more than that of the rare gases.

676 (EPRI-NP—4113-SR, pp 15.1-15.12) **Relationship between fuel element power and the leaching of ^{137}Cs and ^{129}I from irradiated UO_2 fuel.** Johnson, L.H.; Stroes-Gascoyne, S.; Chen, J.D.; Attas, M.E.; Sellinger, D.M.; Delaney, H.G. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The release of ^{137}Cs and ^{129}I from UO_2 fuel element sections (typical of CANDU type reactors) exposed to water at 25°C and at 150°C has been studied as a function of fuel irradiation history. The relationships between the quantities of these nuclides leached at 25°C and the stable xenon release at the end of fuel irradiation are discussed. The results indicate that gap inventories of these nuclides are equal to or less than gap inventories of stable xenon. Preliminary evidence for the rapid leaching, at 150°C, of a fraction of the grain boundary inventory of ^{137}Cs and ^{129}I is also presented.

677 (EPRI-NP—4113-SR, pp 16.1-16.18) **Effects of burnup on fission product release and implications for severe fuel damage events.** Appelhans, A.D.; Cronenberg, A.W.; Carboneau, M.L. (EG & G Idaho, Inc., Idaho Falls). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—). Contract AC07-76ID01570.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Xe, Kr, and I fission-product release data from (a) Halden tests where release in intact rods was measured during irradiation at burnups to 18,000 MWd/t and fuel temperatures of 800-1800 K, and (b) Power Burst Facility (PBF) tests where trace-irradiated fuel (≤ 90 MWd/t) was driven to temperatures of >2400 K and fuel liquefaction occurred, are discussed and related to fuel morphology. Results from both indicate that the fission-product morphology and fuel restructuring govern release behavior. The Halden tests show low release at beginning of life with a 10-fold increase at burnups in excess of 10,000 MWd/t, due to the development of grain boundary interlinkage at higher burnups. Such dependence of release on morphology characteristics is consistent with findings from the PBF tests where, for trace-irradiated fuel, the absence of interlinkage accounts for the low release rates observed during initial fuel heatup, with subsequent enhanced Xe, Kr, and I release via liquefaction or quench-induced destruction of the grain structure. Morphology is also shown to influence the chemical release form of I and Cs fission products.

678 (EPRI-NP—4113-SR, pp 17.1-17.21) **Release of volatile fission products from UO_2.** Prussin, S.G.; Olander, D.R.; Goubeault, P.; Bayen, D. (Lawrence Berkeley Lab., CA). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The release of Xe, I and Te from trace-irradiated unclad pellets of UO_2 into ambient hydrogen containing ~ 100 ppm H_2O has been studied from 1400 to 1750°C by post-irradiation annealing. Above 1500°C, release of Ru, Ba, and Mo was also observed. Fractional releases were determined from the measurement of the intensities of characteristic γ-ray lines of these nuclides in the UO_2 specimen before and after annealing. Booth-model effective diffusion coefficients of I and Te at 1600°C were larger than that of Xe by factors of 2 and 10, respectively, whereas those of Ru, Ba, and Mo were comparable to that of Xe. No release of fission products soluble in UO_2 (Nd and Zr) was observed. Activation energies were found to be 120 +/- 12 for I, 107 +/- 12 for Te and 127 +/- 13 for Xe (in kcal/mole). Concentration profiles measured by precision grinding of thin layers from the annealed specimen surfaces were practically flat in the center, but exhibited steep gradients near the surface.

679 (EPRI-NP—4113-SR, pp 19.1-19.16) **Mechanistic prediction of fission gas, iodine, and cesium release from LWR fuel under degraded-core accident conditions.** Rest, J. (Argonne National Lab., IL). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

The theoretical FASTGRASS-VFP model has been used in the interpretation of fission gas, iodine, and cesium release from (1) irradiated high-burnup LWR fuel in a flowing steam atmosphere during high-temperature, in-cell heating tests performed at Oak Ridge National Laboratory and (2) trace-irradiated LWR fuel during severe fuel-damage (SFD) tests performed in the PBF reactor in Idaho. The results of the analyses demonstrate that intragranular fission product behavior during both types of tests can be interpreted in terms of a grain-growth/grain-boundary-sweeping mechanism that enhances the flow of fission products from within the grains to the grain boundaries. In addition, significant fission product release during the SFD tests depends on fuel fracturing and/or other processes initiated by a requench, and on fuel liquefaction initiated by clad melting. The FASTGRASS-VFP predictions, measured release rates from the above tests, and previously

published release rates are compared and differences between fission product behavior in trace-irradiated and in high-burnup fuel are highlighted.

680 **(EPRI-NP—4113-SR, pp 20.1-20.9) Overview of Marviken experimental procedures.** Collen, J.; Unneberg, H.; Mecham, D. (Studsvik Energiteknik AB, Nykoeping, Sweden). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

This paper discusses the fifth International Reactor Safety Research Project at Marviken, Sweden, in which a series of Aerosol Transport Tests (ATT) are being carried out during 1983-1984. The ATT project studies the effects of accidents in light water power reactors where fuel has been damaged. The accidents are represented by the vaporization of fission product simulants and/or reactor core simulants in the presence of steam, nitrogen, argon and hydrogen. Measurements are made of the thermal-hydraulic conditions present in the system and extensive sampling is undertaken to provide data on aerosol concentration, size distribution, analysis of gaseous species and a complete system mass balance.

681 **(EPRI-NP—4274) Assessment of bolting examination requirements and practices. Final report.** Spanner, J.C. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01 - Research Reports Center, Box 25425, Palo Alto, CA 94303; GPO Dep. File Number DE86001597.

This report documents the results of a limited study to assess bolting examination requirements and practices. Since 1968, at least 50 incidents of bolting degradation and failure have been reported by various operating light water reactor plants, and this report highlights some of these problem areas. The applicable ASME Section III (construction) and ASME Section XI (inservice inspection) requirements are summarized, as are the supplementary inspection requirements recommended by AEC/NRC Regulatory Guide 1.65. At least six development programs have been conducted and documented to evaluate or improve existing ultrasonic capabilities. Several minor changes to the ASME and the NRC requirements are suggested in this report; but these are not expected to significantly improve the limitations that are inherent in the presently applicable UT examination processes which are ineffective for detecting stress corrosion cracking and corrosion wastage. It is recommended that the service sensitivity and/or the safety implications of bolting failures be evaluated in order to develop better guidelines for inservice inspection of bolting and bolting materials based on the service requirements of specific applications. 24 refs., 5 figs., 2 tabs.

682 **(EPRI-NP—4297) Seismic equipment qualification using existing test data.** Smith, C.B.; Merz, K.L. (Anco Engineers, Inc., Culver City, CA (USA)). Oct 1985. 97p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920018.

This report presents the results of the first phase of an ongoing program sponsored by the Electric Power Research Institute with the overall objective of demonstrating the seismic adequacy of as much nuclear power plant equipment as possible by means of collating and evaluating existing seismic qualification test data. These data are used to construct "ruggedness" spectra below which equipment in operating plants designed to earlier earthquake criteria would be generically qualified. The Phase I study developed and applied the technical approaches for collating and evaluating available test data of eight selected equipment classes. This report describes the methodology, presents the Phase I results for the eight classes of equipment, indicates additional classes for which such an evaluation is possible, and provides recommendations for the Phase II effort. 5 refs., 20 figs., 2 tabs.

683 **(EUR—9354) Transition from slow deflagration to detonation.** Koch, C.; Drenckhahn, W. (Commission of the European Communities, Luxembourg). 1984. 6p. Commission of the European Communities, Luxembourg.

The report reviews external vapour cloud explosion phenomena, especially transition from deflagration to detonation, in the context of nuclear power plant safety, for explosions postulated according to the B.M.T. guideline "Chemical Explosions". Damage analyses of recorded accidents show that fast deflagration, not detonation, explains their consequences. Subsequently, laboratory- and large-scale trials are surveyed and safety-related conclusions drawn. Large unconfined cloud field trials (Maplin Sands, China Lake), for propane/butane, evidence negligible overpressures (a few millibar). Balloon tests, for stoichiometric hydrogen-air mixture, up to 2000 m^3, yielded about 60 millibar max. Flame acceleration due to obstacles, nets, turbulence-inducing structures was investigated. Small- to large-scale trials, with hydrogen-air mixtures, show that transition to detonation is restricted to jet ignition. Main safety-related conclusions are: - detonation need not be postulated. Even a partially-confined stoichiometric hydrogen-air cloud generates less than 0.3 bar; - jet ignition should be avoided by appropriate design; - turbulence-inducing obstacles: gratings, pipes, corners merely produce local overpressures and cannot cause transition to detonation.

684 **(FRA—143-3) PWR pressurizer discharge piping system on-site testing.** Anglaret, G.; Lasne, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Aug 1983. 20p. (CONF-830805—101). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752869.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

Framatome PWR systems includes the installation of safety valves and relief valves wich permit the discharge of steam from the pressurizer to the pressurizer relief tank through discharge piping system. Water seal expulsion pluration then depends on valve stem lift dynamics which can vary according to water-stem interaction. In order to approaches the different phenomenons, it was decided to perform a test on a 900 MWe French plant, test wich objectives are: characterize the mechanical response of the discharge piping to validate a mechanical model; open one, two or several valves among the following: one safety valve and three pilot operated relief valves, at a time or sequentially and measure the discharge piping transient response, the support loads, etc.

685 **(GAO/RCED—85-11) Probabilistic risk assessment: an emerging aid to nuclear power plant safety regulation.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 19 Jun 1985. 101p. US General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86900085.

Report to The Chairman, Subcommittee on Energy Conservation and Power, Committee on Energy and Commerce, House of Representatives.

Probabilistic risk assessment (PRA) is a method of quantifying the probabilities of potential accidents and their consequences at nuclear power plants. Nuclear utilities and the Nuclear Regulatory Commission (NRC) have used PRA since 1975 to help improve plant safety and thereby reduce risks to human health and the environment. GAO believes that NRC is making reasonable use of PRA. However, the uses and effectiveness of PRA are still evolving. Since relatively few empirical data on actual plant accidents are available, PRA analyses are and will continue to be affected by many unknowns and uncertainties about internal plant behavior, as well as external events, such as floods. GAO therefore cautions that NRC should not use PRA risk estimates as the sole or primary basis for regulatory decisions. Rather, NRC should use PRA to supplement its more traditional analytical and engineering methods.

686 **(GRS-F—140) Surveys of research projects concerning nuclear facility safety, financed by the Bundesminister des Innern. 9th annual report on SR-projects 1984.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1985. 257p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE85752719.

The FRG's Ministry of the Interior finances studies, expertises and investigations in the field of nuclear safety. The results of such work are meant to clarify questions left open concerning the execution of licensing procedures for nuclear facilities. The GRS (Reactor Safety Company) regularly provides information on the state of such studies, on the authority of the Ministry of the Interior. Each progress report is a collection of individual reports, cate-

gorized by subject matter. They are a documentation of the contractor's progress, rendered by themselves on standardized forms, published, for the sake of general information on progress made in investigations concerning reactor safety, by the project attendance department of the GRS. The individual reports have serial numbers. Each report includes particulars of the objective, work carried out, results obtained and plans for project continuation.

687 (IAEA-SM—281/41) **Chemistry and transport of iodine in containment.** Beahm, E.C.; Shockley, W.E.; Weber, C.F. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 35p. (CONF-851019—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85018064.

From International symposium on source term evaluation for accident conditions; Columbus, OH, USA (28 Oct 1985).

The description of containment iodine behavior in reactor accident sequences involves a combination of iodine volatility effects, deposition/revaporization chemical reactions, and mass transport of iodine species. The experimental work in this program has largely centered on the interactions of iodine in or with water pools. The development of a model of iodine behavior, as presented here, begins with the identification of factors in the transport and chemistry of iodine, and then proceeds with a description of the structure of the model. 14 refs., 3 figs., 3 tabs.

688 (INIS-BR—289) **Dynamic power behavior of a PWR type nuclear reactor.** Moreira, F.J. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1984. 163p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780104.

A method for evaluating the power level (dynamic behavior) in a PWR type reactor during a transient is derived by solving the point kinetic equation related to the control rod insertion effects and fuel or moderator temperature feedback. A new version of the thermal-hydraulic code COBRA III P/MIT is used.

689 (INIS-BR—302) **Numerical solution model of the rewetting of a nuclear fuel rod.** Braz Filho, F.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1984. 151p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780038.

The study of thermal behaviour of a nuclear reactor fuel rod during the reflooding phase of the loss-of-coolant accident (LOCA) is presented. A mathematical model and a numerical scheme were proposed in order to solve the bidimensional heat conduction equation in cylindrical coordinates. The phenomenon of reflooding is not completely understood. One of the main difficulties is to estimate the heat transfer coefficient (h). For this reason two different models were elaborated: in the first three regions are considered and in each region h is considered constant; in the second the h profile is adjusted according to the boiling curve. The three region model yields satisfactory results at high and low mass flows while the boiling curve model yields reasonable at low flows. (Author).

690 (INIS-mf—9472, pp 96) **Environmental monitoring of radiation doses and fields using solid-state dosimetry.** Kvasnicka, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Abstr.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

691 (INIS-mf—9910-Vol.1, pp 1-20) **Containment system design and post-LOCA radiation safety analysis using the FISSCON II code.** Jamieson, T.J.; Fluke, R.J. (Ontario Hydro, Toronto (Canada)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The computer code FISSCON II predicts fission product behaviour in containment following a LOCA. The models involved simulate both natural and engineered processes including radioactive decay, plateout, washout, desorption, leakage and filtered exhaust. The code was originally developed at Ontario Hydro as a containment system design tool to assess the design of special containment subsystems including the Filtered Air Discharge System (FADS). More recently, it is being used for radiation safety analysis in support of reactor licensing submissions. This paper outlines the variety of uses of FISSCON II in safety analysis and containment design, including the determination of subsidiary design requirements such as radiation shielding and cooling for the FADS, stack activity monitoring, and environmental qualification of equipment. Code validation against experiments and observations, including those observations at Three Mile Island, is also discussed.

692 (INIS-mf—9910-Vol.1, pp 34-43) **Heat removal capability of steam generators under reflux cooling modes in a CANDU-PHT system.** Chang, J.-S.; Girard, R.; Revankar, S.; Wan, P.T. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Engineering Physics); Midvidy, W.I.; Pauls, R.E.; Sergejewich, P. (Ontario Hydro, Toronto (Canada)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Reflux condensation in steam generator tubes may be an important heat removal mechanism in certain loss-of-coolant accidents in nuclear power plants. The effects of system pressure, cooling water temperature, length of the single-phase region and tube diameter on the heat removal capacity of a single tube under complete reflux are examined experimentally. Flow regime observations of reflux condensation in a single tube and a four U-tube steam generator model are presented.

693 (INIS-mf—9910-Vol.1, pp 44-61) **Method for calculating CANDU fuel channel flow following inlet header stratification.** Bowman, W.C. (Monserco Ltd., Mississauga, Ontario (Canada)); Hopwood, J.M. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. CANDU Operations). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

An analytical technique has been developed which, in conjunction with heat transport system thermalhydraulic computer code predictions, estimates individual channel coolant flows following inlet header stratification in CANDU reactors. The method permits channel flow, and hence fuel cooling, to be predicted during certain postulated accidents, after heat transport flows have degraded to the point where steam/liquid phase separation occurs at the inlet header. In the method, the channels fed by the inlet header are divided into two groups; one fed by steam and one fed by liquid. The numbers of channels in each group are calculated based on predicted total inflow of steam and water to the reactor header, and on the pressure drop/flow characteristics of steam-fed and liquid-fed channels respectively. The technique has been applied to calculate channel flows during a hypothetical small loss of coolant accident coupled with unavailable emergency coolant injection. Steam flows averaging about 0.1 kg/s are predicted following inlet header stratification.

694 (INIS-mf—9910-Vol.2, pp 1-7) **Improvement to electric motor operated valves of the emergency coolant injection system.** Yousef, N.; McCutcheon, R. (Ontario Hydro, Toronto (Canada)). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Ontario Hydro's significant event reports identified electric motor operated valves as major contributors to the emergency coolant injection system unavailability. A study was initiated by Ontario Hydro and funded by CANDEV program to define the problem and propose solutions. The study identified that 40 percent

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of the failures of electric motor operated valves were due to malfunction of torque and position limit switches, and thermal overload protection device. The following modifications were proposed: mount additional position limit switches on valve yokes; use 2 out of 3 logic to control actuator operation; and use a different thermal overload protection device with more suitable operating characteristics.

695 (INIS-mf—9910-Vol.2, pp 44-54) **Decommissioning of nuclear facilities.** Nemec, J. (Bechtel National, Inc., Oak Ridge, TN (USA)). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The decommissioning of nuclear facilities at the end of their useful life has received increased attention during the last several years. There have been several conferences dedicated to the subject, expert groups have been assembled to discuss particular aspects and the U.S. Nuclear Regulatory Commission is currently reevaluating decommissioning policy and regulations. All of this activity has led to several conclusions, the most important one being that decommissioning of retired nuclear facilities is technically feasible and that the costs though sometimes large are manageable. This paper provides an overview of the decommissioning process with particular emphasis on planning and regulations.

696 (INIS-mf—9910-Vol.2, pp 55-68) **Frances's experience in the field of decommissioning.** Cregut, A. (CEA (France)); Vigreux, B. (Societe Generale pour les Techniques Nouvelles S.G.N., 78 - Saint-Quentin-en-Yvelines (France)). 1983. (In French). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The authors present the main concepts used in the decommissioning programs either underway or completed in France. They also list some of the technology that was necessary to the operation. Some examples are given also to the role played by the engineers in the implementation of the research and development program.

697 (INIS-mf—9910-Vol.2, pp 34-54) **Analysis of effects of calandria tube uncovery under severe accident conditions in CANDU reactors.** Rogers, J.T.; Currie, T.C.; Atkinson, J.C.; Dick, R. (Carleton Univ., Ottawa, Ontario (Canada). Faculty of Engineering). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

A study is being undertaken for the Atomic Energy Control Board to assess the thermal and hydraulic behaviour of CANDU reactor cores under accident conditions more severe than those normally considered in the licensing process. In this paper, we consider the effects on a coolant channel of the uncovery of a calandria tube by moderator boil-off following a LOCA in a Bruce reactor unit in which emergency cooling is ineffective and the moderator heat sink is impaired by the failure of the moderator cooling system. Calandria tube uncovery and its immediate consequences, as described here, constitute only one part of the entire accident sequence. Other aspects of this sequence as well as results of the analysis of the other accident sequences studied will be described in the final report on the project and in later papers.

698 (INIS-mf—9910-Vol.2, pp 55-58) **CANDU fuel bundle behaviour during degraded cooling conditions.** Hadaller, G.I. (Westinghouse Canada Ltd., Hamilton, Ontario); Archinoff, G.H. (Ontario Hydro, Toronto (Canada)); Kohn, E. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. CANDU Operations). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Accident analysis for CANDU reactors considers a wide range of postulated break size and location in the heat transport piping. Coincident failure of the emergency coolant injection system to operate on demand is also considered, leading to severely degraded core cooling conditions for an indefinite period of time. These conditions are characterized by a low flow of steam and hydrogen across the fuel, severe fuel and fuel channel temperature excursions and thermal-mechanical distortions of fuel and fuel channel assemblies. This paper presents results of the first in a series of experiments designed to determine the behaviour of CANDU fuel bundles during accidents with prolonged degraded cooling.

699 (KFK—3873) **Probabilistic SSYST-3 analysis for a PWR-core during a large break LOCA.** Schubert, J.D.; Gulden, W.; Jacobs, G.; Meyder, R.; Sengpiel, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). May 1985. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85752708.

This report demonstrates the SSYST-3 analysis and application for a German PWR of 1300 MW. The report is concerned with the probabilistic analysis of a PWR core during a loss-of-coolant accident due to a large break. With the probabilistic analysis, the distribution functions of the maximum temperatures and cladding elongations occuring in the core can be calculated. Parameters like rod power, the thermohydraulic boundary conditions, stored energy in the fuel rods and the heat transfer coefficient were found to be the most important. The expected value of core damage was determined to be 2.9% on the base of response surfaces for cladding temperature and strain deduced from SSYST-3 single rod results.

700 (LA-UR—85-946) **Analysis of multiple-tube ruptures in both steam generators for the Three Mile Island-1 pressurized water reactor.** Nassersharif, B. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 30p. (CONF-851007—6). NTIS, PC A03/MF A01 - GPO. File Number TI85010105.

From 3. international meeting on reactor thermal hydraulics; Newport, RI, USA (15 Oct 1985).

The operator guidelines were followed for both transients described. Both transients resulted in SG overfill and the tube-rupture flow did not terminate in either transient. The following statements can be deducted from the results of the calculations: the tube-rupture flow could not be stopped for either case during 2600 s (43 min) of transient time; each accident scenario resulted in SG overfill; both SGs overfilled by 1600 s (27 min) and 1800 s (30 min) for Cases 1 and 2, respectively; conditions for isolation of the SGs were not reached; and core subcooling was not lost in either case but the upper head was voided in Case 2. Comparison of the cooldown rates in the two cases after 1200 s (20 min) shows that these rates are equal (i.e., restart of the RCPs did not change the primary-system cooldown rate). However, in Case 2, a steam bubble was formed in the upper head, which did not disappear during the simulated time. One of the immediate actions in the guidelines was to fill both SGs to 95% level. This step was almost unnecessary because the tube-rupture flow was large enough that the 15.4 - mK/s (100 - °F h) cooldown-rate limit was exceeded and AFW could not be injected. Also, the guidelines did not address the SG overfill issue.

701 (NEDO—30967) **Large-scale demonstration of barrier fuel in the Quad Cities Unit 2 Nuclear Power Station.** Rowland, T.C.; Paustian, H.H.; Rosenbaum, H.S.; Furtado, D.T.; Thompson, J.R.; Wood, J.E. (General Electric Co., San Jose, CA (USA). Nuclear Energy Business Operations). Apr 1985. Contract AC02-77ET34001. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85016089.

LWR nuclear fuel is susceptible to pellet cladding interaction (PCI) failures when subjected to fast power increases at mod-

erate to high exposures. Zirconium barrier fuel was invented as a material solution to the PCI failure problem. This report describes the results of large-scale demonstrations of Zr-barrier fuel in the Quad Cities Unit 2 reactor. The demonstrations involved fast power increases on 16 bundles caused by stepwise (6 pulls) withdrawal of adjacent control blades. The first demonstration was performed in March 1983 at approximately 6 GWd/MTU and the fuel was subjected to power increases of up to 10 kW/ft to peak power levels of 12.6 kW/ft. The second demonstration was completed in March 1985 at an exposure of about 15 GWd/MTU. Peak power levels up to 13.7 kW/ft were achieved. All the ramped fuel was sound, both from plant offgas measurements and by fuel sipping.

702 **(NUREG—1155-Vol.1) Research program plan: reactor vessels. Volume 1.** Vagins, M.; Taboada, A. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Jul 1985. 38p. NTIS, PC A03/MF A01 - GPO. File Number TI85901966.

The ability of the licensing staff of the NRC to make decisions concerning the present and continuing safety of nuclear reactor pressure vessels under both normal and abnormal operating conditions is dependent upon the existence of verified analysis methods and a solid background of applicable experimental data. It is the role of this program to provide both the analytical methods and the experimental data needed. Specifically, this program develops fracture mechanics analysis methods and design criteria for predicting the stress levels and flaw sizes required for crack initiation, propagation, and arrest in LWR pressure vessels under all known and postulated operations conditions. To do this, not only must the methods be developed but they must be experimentally validated. Further, the materials data necessary for input to these analytical methods must be developed. Thus, in addition to methods development and large scale experimental verification this program also develops data to show that slow-load fracture toughness, rapid-load fracture toughness, and crack arrest toughness obtained from small laboratory specimens are truly representative of the toughness characteristics of the material behavior in pressure vessels in both the unirradiated and the irradiated conditions.

703 **(NUREG—1155-Vol.3) Research program plan: piping. Volume 3.** Vagins, M.; Strosnider, J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Jul 1985. 15p. NTIS, PC A02/MF A01 - GPO. File Number TI85901968.

Regulatory issues related to piping can be divided into the three areas of pipe cracking, postulated design basis pipe breaks, and design of piping for seismic and other dynamic loads. The first two of these issues are in the domain of the Materials Engineering Branch (MEBR), while the last of the three issues is the responsibility of the Mechanical/Structural Engineering Branch. This volume of the MEBR Research Plan defines the critical aspects of the pipe cracking and postulated design basis pipe break issues and identifies those research efforts and results necessary for their resolution. In general, the objectives of the MERB Piping Research Program are to provide experimentally validated analytic techniques and appropriate material properties characterization methods and data to support regulatory activities related to evaluating and ensuring piping integrity.

704 **(NUREG/CR—1122) Development of an ultrasonic imaging system to measure the size and velocity of large bubbles rising through liquids.** Adler, L.; Fitting, D.; Lattimer, J.; Wright, A.L. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract AC05-84OR21400. 44p. (ORNL/NUREG/TM—364). NTIS, PC A03/MF A01 - GPO. File Number TI86000150.

A real-time ultrasonic imaging system was developed to permit the simultaneous measurement of the radii and velocities of large bubbles rising through a liquid. It was constructed as a possible technique for studying the dynamics of large bubbles rising in liquid sodium. The characterization of such bubbles is one part of a program at the Oak Ridge National Laboratory known as the Fuel Aerosol Simulant Test (FAST). The purpose of the FAST program is to investigate events following a simulated hypothetical core-disruptive accident in a liquid-metal fast breeder reactor. The accuracy and limitations of the system were determined by evaluating the rise of a variety of solid and air-filled spherical test targets in water. Diameter of the test spheres ranged from 3.3 to 24.1 cm; magnitudes of the rise velocities ranged from ~40 cm/s to ~1 m/s. The uncertainty in radii measurements within the interval from 3.3 to 9.10 cm was estimated to be within +-7% at a 95% confidence level. Theoretical calculations of the rise velocities were compared with the measurements performed using the ultrasonic dynamic imaging (UDI) system. In addition, independent experimental measurements of the rise velocities were obtained with a laser-photocell system. Based on those comparisons, the uncertainty in velocity measurements, at a confidence level of 95%, was estimated to be within +-17%. That estimate was made based on the sphere size measured using the UDI system. 19 refs., 17 figs., 10 tabs.

705 **(NUREG/CR—1386) Fission product release from highly irradiated LWR fuel heated to 1300 to 1600°C in steam.** Lorenz, R.A.; Collins, J.L.; Malinauskas, A.P. Osborne, M.F.; Towns, R.L. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract AC05-84OR21400. 62p. (ORNL/NUREG/TM—346). NTIS, PC A04/MF A01 - GPO. File Number TI85015941.

Four tests were performed with high-burnup light water reactor (LWR) fuel to explore the amount and characteristics of fission product release at short heating times (0.4 to 10 min) in steam atmosphere in the temperature range 1300 to 1600°C. The test fuel rod segments were cut from full-length fuel rods irradiated at low heat rating to 30,000 MWd/MT in the H.B. Robinson-2 reactor. The releases of cesium and iodine increased tenfold (~0.3 to >4%) with temperature from 1350 to 1400°C from fuel with defects that simulate ruptured cladding. Krypton release rose from ~2 to ~11% of total inventory in this temperature range. This sudden increase in release of krypton, cesium, and iodine is believed to result from prior accumulations of these species at or very near the grain boundaries. At 1600°C, the releases of krypton, cesium, and iodine were in the range 17 to 25% of total fuel inventory.

706 **(NUREG/CR—1864-Vol.2) Study of nonequilibrium flashing of water in a converging-diverging nozzle. Volume 2. Modeling.** Wu, B.J.C.; Abuaf, N.; Saha, P. (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 163p. (BNL-NUREG—51317-Vol.2). NTIS, PC A08/MF A01 - GPO. File Number TI85015953.

A steady water loop with well controlled flow and thermodynamic conditions was designed, built, and made operational for the measurement of net vapor generation rates under nonequilibrium conditions. The test section consists of a converging-diverging nozzle with 49 pressure taps and two observation windows at the exit. Pressure distributions, photographic observations, diametrical averaged centerline void fraction distributions, detailed transverse distributions of the chordal averaged void fractions at 27 axial locations, and area averaged void fraction distributions along the nozzle were recorded under various flashing conditions. The development of voids in nonequilibrium flashing flows is shown to be dependent on three major factors of the void inception point which determines the initial and subsequent liquid superheats and must be accurately described; of the interfacial mass transfer rates, which depend on the local superheat and must be specified; and the local interfacial area density where the mass transfer occurs. The flashing onset correlation of Alamgir and Lienhard was extended to predict flashing inception in pipe and nozzle flows with subcooled inlet conditions. A void development model for bubbly flows was based on a simple concept for interfacial area density in conjunction with a conduction-controlled bubble growth law. A general model of vapor generation following flashing inception was also developed. In this model, bubbly flow, bubbly-slug flow, a transitional flow comprising the annular and annular-mist regimes and finally fully dispersed droplet flow were assumed to occur at successively higher void fraction ranges. On the basis that flashing inception occurred at the throat in nozzle flows with subcooled inlet conditions, and that the pressure undershoot can be calculated, a method of calculating the critical mass flow rates through nozzles was proposed, and it was checked with existing data.

707 **(NUREG/CR—1924) FRANTIC II: a computer code for time dependent unavailability analysis.** Vesely, W.E.; Goldberg, F.F.; Powers, J.T.; Dickey, J.M.; Smith, J.M.; Hall, R.E. (Brookhaven National Lab., Upton, NY (USA)). Apr 1981. Contract AC02-76CH00016. 98p. (BNL-NUREG—51355). NTIS, PC A05/MF A01 - GPO. File Number TI86000902.

The FRANTIC computer code evaluates the time dependent and average unavailability for any general system model. The code is written in FORTRAN IV for the CDC 7600 computer. Non-repairable components, monitored components, and periodically tested components are handled. One unique feature of FRANTIC is the detailed, time dependent modeling of periodic testing which includes the effects of test downtimes, test overrides, detection inefficiencies, and test-caused failures. Burn-in and wear-out effects are included by using a time dependent failure rate for the components. Continuous changes in the failure rate are modeled by a Weibull distribution and the failure rate may also change discontinuously at each test. Periodic equations are developed and, optionally, renewals may occur at either test or repair. Human errors and common mode failures can be included by assigning an appropriate constant probability for the contributors.

708 **(NUREG/CR—1937) Feasibility of dynamic testing of as-built nuclear power plant structures: an interim evaluation.** Srinivasan, M.G.; Kot, C.A.; Hsieh, B.J.; Chung, H.H. (Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 53p. (ANL-CT—81-5). NTIS, PC A04/MF A01 - GPO. File Number TI86000886.

An interim evaluation of the feasibility and meaningfulness of dynamic testing of as-built nuclear power plant structures is the subject of this report. A critical review of past dynamic tests on nuclear power plant and other structures, data processing techniques, and associated analytical methods forms the basis for the evaluation. Goals of dynamic tests, excitation techniques, excitation levels, instrumentation, data acquisition, data analysis, determination of dynamic characteristics from test data, and post-test analytical modeling including different parameter identification approaches are discussed. Dynamic testing is found to be feasible, and low-level testing is deemed to be useful for verifying analytical models used in design practice. Proof testing at design-level excitation is considered impractical, and only a combined low-level testing cum analytical modeling approach is considered to be the means for predicting response to high-level excitations. The need for better analytical modeling and for the validation of existing and proposed analytical methodologies calls for further effort before testing can become part of the normal licensing process.

709 **(NUREG/CR—1979) Probability based load criteria for the design of nuclear structures: a critical review of the state-of-the-art.** Shinozuka, M.; Ellingwood, B.R.; Wang, P.C.; Meyer, C.; Wen, Y.K.; Kao, S.; Shooman, M.L.; Philippacopoulos, A.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1981. Contract AC02-76CH00016. 270p. (BNL-NUREG—51356). NTIS, PC A12/MF A01 - GPO. File Number TI86000891.

Structures for nuclear power plant facilities must be designed to withstand safely and effectively all kinds of loads and load combinations that may be expected to occur during their lifetime. The traditional methods of structural design attempt to account for the inevitable variability in the loads, material strengths, in-service environments, and fabrication process, etc., through the use of safety factor, allowable stresses or load and resistance factors. These approaches may result in an unknown and nonuniform reliability because of the subjective manner in which the safety factors have been determined. The stochastic nature loads and the uncertainties in material properties dictate a probabilistic approach for a rational assessment of structural safety and performance. This report presents: an in-depth review of the state-of-the-art pertaining to probability-based analysis and design of civil engineering structures; basis for extending existing probability-based methods to seismic category I nuclear structures; and the availability of the pertinent data required to perform probabilistic analysis for seismic category I nuclear structures.

710 **(NUREG/CR—2000-Vol.1-No.4) Licensee Event Report (LER) compilation for month of April 1982. Volume 1, No. 4.** (Oak Ridge National Lab., TN (USA)). Jun 1982. Contract AC05-84OR21400. 119p. (ORNL/NSIC—200-Vol.1-No.4). NTIS, PC A06/MF A01 - GPO. File Number TI86000971.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC). The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting are described in detail in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, and keyword indexes follow the summaries. The components and systems are those identified by the utility when the LER form is initiated; the keywords are assigned by the NSIC staff when the summaries are prepared for computer entry.

711 **(NUREG/CR—2000-Vol.1-No.7) Licensee Event Report (LER) compilation for month of July 1982. Volume 1, No. 7.** (Oak Ridge National Lab., TN (USA)). Aug 1982. Contract AC05-84OR21400. 149p. (ORNL/NSIC—200-Vol.1-No.7). NTIS, PC A07/MF A01 - GPO. File Number TI86000917.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting are described in detail in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, and keyword indexes follow the summaries. The components and systems are those identified by the utility when the LER form is initiated; the keywords are assigned by the NSIC staff when the summaries are prepared for computer entry.

712 **(NUREG/CR—2015-Vol.5) Seismic Safety Margins Research Program. Phase I, final report. Major structure response (Project IV). Volume 5.** Benda, B.J.; Johnson, J.J.; Lo, T.Y. (Structural Mechanics Associates, San Ramon, CA (USA); Lawrence Livermore National Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 87p. (UCRL—53021-Vol.5). NTIS, PC A05/MF A01 - GPO. File Number TI86000955.

Task of the Major Structure Response Project within the Seismic Safety Margins Research Program (SSMRP) was to develop detailed finite element models of the Zion Nuclear Power Plant's containment building and auxiliary-fuel-turbine (AFT) complex. The resulting models served as input to the seismic methodology analysis chain.

713 **(NUREG/CR—2039) Dynamic combinations for Mark II containment structures.** Philippacopoulos, A.J.; Reich, M. (Brookhaven National Lab., Upton, NY (USA)). Jun 1982. Contract AC02-76CH00016. 174p. (BNL-NUREG—51366). NTIS, PC A08/MF A01 - GPO. File Number TI86000972.

The behavior of a representative Mark II containment is investigated with respect to its structural capacity when subjected to various load combinations that may be expected during its lifetime. Mathematical models based on finite element idealization procedures are developed and verified. These include three-dimensional finite element models and the so-called stick models of the Mark II containment system. The latter are employed for soil-structure interaction analysis. Various BNL computer codes are utilized to evaluate structural responses. A set of loads are compiled from re-

viewing the current literature. The combinations are performed by employing both the Absolute Sum (ABS) and Square-Root-of-the-Sum-of-the-Squares (SRSS) methods. In addition, a probabilistic evaluation of the combination outcome is carried out by using a Monte-Carlo technique. This is done by generating cumulative distribution functions (CDF's) expressing the nonexceedance probability (NEP) level of the maxima of the combinations. The results from a set of 800 combination cases are demonstrated.

714 **(NUREG/CR—2061) Brief analysis of the transient fluid flow at the entrance of the upper core structure during a hypothetical core expansion.** Wilhelm, D. (Los Alamos Scientific Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 22p. (LA—8806-MS). NTIS, PC A02/MF A01 - GPO. File Number TI86000892.

SIMMER-II has been used to calculate a one-dimensional approximation to the core expansion following a hypothetical core-disruptive accident in a Liquid Metal Fast Breeder Reactor (LMFBR). The transient, multicomponent, fluid flow at the entrance of the intact upper core structure is the subject of the present investigation. Additional calculations were performed for droplet deposition into and entrainment of liquid films at the upper-core-structure walls and for transient single-phase flows.

715 **(NUREG/CR—2087) Load combination methodology development. Load combination program. Project II final report.** Schwartz, M.W.; Ravindra, M.K.; Cornell, C.A.; Chou, C.K. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 144p. (UCRL—53025). NTIS, PC A07/MF A01 - GPO. File Number TI86000900.

This report documents the results of Phase I of a research project to formulate a probabilistic methodology for developing consistent criteria for the design of nuclear power plant components. A method for calculating the reliability of an individual component subjected to static and dynamic loads is developed and applied to the evaluation of reliability implied by a set of design criteria. In addition, load and resistance factors are derived such that the resulting components have, on the average, specified target component reliabilities. Since the design criteria evaluation/development requires that a number of components be studied, a simulation procedure is developed to economically obtain a population of representative component designs. Finally, some preliminary studies for allocating component target reliabilities have been made.

716 **(NUREG/CR—2104) ARAC feasibility study for the NRC. Phase II, final report.** Rosen, L.C.; Lawver, B.S.; Orphan, R.C. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 26p. (UCRL—52750). NTIS, PC A03/MF A01 - GPO. File Number TI86000914.

The factors involved in the implementation of ARAC (Atmospheric Release Advisory Capability) services as a nationwide capability for a large number, possibly all, licensed nuclear power plants for a period of several decades are examined. Sets of options available for the employment of the ARAC system are analyzed with respect to potential benefits, limitations and costs. Outlines are presented of possible programs for training, familiarization and participation in emergency response exercises.

717 **(NUREG/CR—2108) Scale-model study of the seismic response of a nuclear reactor core.** Dove, R.C.; Dunwoody, W.E.; Rhorer, R.L. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 24p. (LA—8772-MS). NTIS, PC A02/MF A01 - GPO. File Number TI86000908.

The use of scale models to study the dynamics of a system of graphite core blocks used in certain nuclear reactor designs is described. Scaling laws, material selection, model instrumentation to measure collision forces, and the response of several models to simulated seismic excitation are covered. The effects of (1) Coulomb friction between the blocks, and (2) the clearance gaps between the blocks on the system response to seismic excitation are emphasized. 6 refs., 10 figs., 6 tabs.

718 **(NUREG/CR—2116) High-temperature gas-cooled reactor safety studies for the Division of Reactor Safety Research. Quarterly progress report, October 1-December 31, 1980.** Ball, S.J.; Cleveland, J.C.; Conklin, J.C.; Harrington, R.M. (Oak Ridge National Lab., TN (USA)). Jun 1981. Contract AC05-84OR21400. 16p. (ORNL/TM—7809). NTIS, PC A02/MF A01 - GPO. File Number TI86000942.

Analyses in support of licensing questions on the Fort St. Vrain (FSV) reactor were continued. Investigations of the FSV core-support thermal stress problem were completed. Initial work was done on experiment plans for FSV tests that would yield data needed to reduce uncertainties in accident code predictions. Work also continued on development of two codes for simulating high-temperature gas-cooled reactor dynamics, ORECA (for core thermal hydraulics) and ORTURB (for steam turbine plant).

719 **(NUREG/CR—2161) Advanced Reactor Safety Research Division quarterly progress report, January 1-March 31, 1981.** Cerbone, R.J.; Ginsberg, T.; Guppy, J.G.; Sastre, C. (Brookhaven National Lab., Upton, NY (USA)). May 1981. Contract AC02-76CH00016. 98p. (BNL-NUREG—51402). NTIS, PC A05/MF A01 - GPO. File Number TI86000938.

The Advanced Reactor Safety Research Programs Quarterly Progress Report describes current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the USNRC Division of Reactor Safety Research. The projects reported each quarter are the following: HTGR Safety Evaluation, SSC Code Development, LMFBR Safety Experiments, and Fast Reactor Safety Code Validation.

720 **(NUREG/CR—2181-Vol.1) Physics of reactor safety. Quarterly report, January-March 1981.** (Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 30p. (ANL—81-29-Vol.1). NTIS, PC A03/MF A01 - GPO. File Number TI86000890.

This quarterly progress report summarizes work done during the months of January-March 1981 in Argonne National Laboratory's Applied Physics and Components Technology Divisions for the Division of Reactor Safety Research of the US Nuclear Regulatory Commission. The work in the Applied Physics Division includes reports on reactor safety modeling and assessment by members of the Reactor Safety Appraisals Section. Work on reactor core thermal-hydraulics is performed in ANL's Components Technology Division, emphasizing 3-dimensional code development for LMFBR accidents under natural convection conditions. An executive summary is provided including a statement of the findings and recommendations of the report.

721 **(NUREG/CR—2221-Vol.1) High-temperature gas-cooled reactor safety studies for the Division of Reactor Safety Research. Quarterly progress report, January 1-March 31, 1981.** Ball, S.J.; Cleveland, J.C.; Conklin, J.C.; Harrington, R.M. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract AC05-84OR21400. 17p. (ORNL/TM—7889). NTIS, PC A02/MF A01 - GPO. File Number TI86000882.

Development and verification work continued on Ford St. Vrain (FSV) reactor dynamics codes. Verification activities included comparisons of code predictions with data from a 35% power scram that occurred after installation of the region constraint devices. Assistance was also given to the Office of Nuclear Reactor Regulation in assessing FSV plans for testing at power levels up to 100%.

722 **(NUREG/CR—2221-Vol.2) High-temperature gas-cooled reactor safety studies for the Division of Reactor Safety Research. Quarterly progress report, April 1-June 30, 1981.** Ball, S.J.; Cleveland, J.C.; Conklin, J.C.; Harrington, R.M. (Oak Ridge National Lab., TN (USA)). Nov 1981. Contract AC05-84OR21400. 13p. (ORNL/TM—8091). NTIS, PC A02/MF A01 - GPO. File Number TI86000933.

Work continued on the development of the ORTAP and ORECA codes, which are used in accident sequence analyses of the Fort St. Vrain high-temperature gas-cooled reactor (HTGR). Initial work was also done on an HTGR severe accident sequence

analysis task, which will study low-probability accidents that lead to core damage.

723 **(NUREG/CR—2299-Vol.1) LMFBR Aerosol Release and Transport Program quarterly progress report, January-March 1981. Volume 1.** Kress, T.S.; Tobias, M.L. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract AC05-84OR21400. 35p. (ORNL/TM—7946). NTIS, PC A03/MF A01 - GPO. File Number TI86000937.

This report summarizes progress for the Aerosol Release and Transport Program sponsored by the Division of Reactor Safety Research of the Nuclear Regulatory Commission for the period January-March 1981. Topics discussed include (1) preparations for under-sodium tests at the Fuel Aerosol Simulant Test Facility, (2) revisions of the experimental plan for these tests, (3) development of an acoustic bubble detection system, (4) U_3O_8 in steam [lightwater reactor (LWR) accident] aerosol experiments conducted in the Nuclear Safety Pilot Plant (NSPP), (5) four iron-oxide aerosol experiments conducted at the CRI-II, (6) development of experimental facilities for the core-melt aerosol program, and (7) work connected with implementation of the UVABUBL bubble oscillation code.

724 **(NUREG/CR—2299-Vol.2) LMFBR aerosol release and transport program. Quarterly progress report, April-June 1981. Volume 2.** Kress, T.S.; Tobias, M.L. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract AC05-84OR21400. 27p. (ORNL/TM—7974). NTIS, PC A03/MF A01 - GPO. File Number TI86000918.

Topics discussed include: (1) preparation for under-sodium tests at the Fast Aerosol Simulant Test Facility; (2) revisions of the experimental plan for these tests; (3) development of an acoustic bubble detection system; (4) progress in interpretation of Oak Ridge National Laboratory-Sandia normalization test results; (5) U_3P_8 in steam (lightwater reactor accident) aerosol experiments conducted in the NSPP; (6) plasma torch generation of SnO_2 and SiO_2 aerosols at the CRI-II facility; (7) development of initial fuel-melting tests in small-scale experimental facilities for the core-melt aerosol program; and (8) development of specifications for a full-scale core-melt facility.

725 **(NUREG/CR—2542) Sensitivity study using the FRANTIC code for the unavailability of a system to the failure characteristics of the components and the operating conditions.** Ginzburg, T.; Dickey, J.M.; Hall, R.E. (Brookhaven National Lab., Upton, NY (USA)). Feb 1982. Contract AC02-76CH00016. 112p. (BNL-NUREG—51504). NTIS, PC A06/MF A01 - GPO. File Number TI86000968.

The purpose of this report is to show how the code FRANTIC II can be used to explore the sensitivity of the calculated unavailability of a system to various parameters. Several generic systems are analyzed in detail. The study illustrates the effect of uncertainties in the empirical data and helps assess the relative importance of collecting more accurate data for particular components. The study also helps in deciding whether it is worth improving a particular component or whether such improvement would have little effect. In addition, the impact of changing operational procedures can be assessed, and different operating strategies can be compared. Change of some procedures may yield only slight improvement, whereas in other instances a small change in timing may have a significant effect. Thus, this report shows how FRANTIC II may be a useful and powerful tool in the analysis of the reliability of a complex system, and in the determination of the more significant factors.

726 **(NUREG/CR—2543) Study of the feasibility of microwave dielectric heating for LMFBR transition phase accident sequence boiling studies.** Makowitz, H.; Ginsberg, T. (Brookhaven National Lab., Upton, NY (USA)). Dec 1981. Contract AC02-76CH00016. 119p. (BNL-NUREG—51506). NTIS, PC A06/MF A01 - GPO. File Number TI86000969.

The adequacy of microwave heating is judged based upon the criterion of heating uniformity per unit liquid volume and upon the ability to analytically characterize the liquid power density distribution. Two aspects of liquid power density uniformity are addressed. Microwave oven irradiation of water as the test fluid was considered as one alternative. Alternate fluids were also considered. It is judged that it is not appropriate to use a microwave oven for the boiling simulation studies. It is concluded that the use of microwave radiation, while not straightforward, is feasible for simulation of the nuclear heat source in transition phase boiling studies. A waveguide, with a cyclohexane-ethanol test fluid, will satisfy two of the major requirements.

727 **(NUREG/CR—3633-Vol.4) TRAC-BD1/MOD1: an advanced best estimate computer program for boiling water reactor transient analysis. Volume 4. Developmental assessment.** Shumway, R.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1985. Contract AC07-76ID01570. 96p. (EGG—2294-Vol.4). NTIS, PC E04/MF A01 - GPO. File Number TI86000039.

Includes 2 sheets of 24x reduction microfiche.

This volume of the TRAC-BD1/MOD1 manual discusses the results of developmental assessment calculations performed mainly with a preliminary version of TRAC-BD1/MOD1 (V21), and some selected cases performed with the official version of TRAC-BD1/MOD1 (V22), which differed from the preliminary version due to a few small corrections. A total of 21 test cases have been performed, ranging in complexity from simple single-effect flow tests up to a full BWR/6 system calculation. Appendices in the form of microfiches are included at the end of this report.

728 **(NUREG/CR—3816-4-Vol.32) Reactor Safety Research. Quarterly report, October-December 1984. Volume 32.** (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 239p. (SAND—84-1072-4-Vol.32). NTIS, PC A11/MF A01 - GPO. File Number TI86000725.

Sandia National Laboratories is conducting, under the US NRC's sponsorship, phenomenological research related to the safety of commercial nuclear power reactors. The research includes experiments to simulate the phenomenology of accident conditions and the development of analytical models, verified by experiment, which can be used to predict reactor and safety systems performance and behavior under abnormal conditions. Objective of this work is to provide NRC requisite data bases and analytical methods to (1) identify and define safety issues, (2) understand the progression of risk-significant accident sequences, and (3) conduct safety assessments.

729 **(NUREG/CR—4043) Data summary report for fission product release test HI-6.** Osborne, M.F.; Collins, J.L.; Lorenz, R.A.; Norwood, K.S.; Travis, J.R.; Webster, C.S. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 61p. (ORNL/TM—9443). NTIS, PC A04/MF A01 - GPO. File Number TI85018314.

The sixth in a series of high-temperature fission product release tests was conducted for 1 min at 1950°C in a steam-helium atmosphere. The 15.2-cm-long test specimen was a section of fuel rod which was irradiated to 40.3 MWd/kg in the Monticello BWR. Based on fission product inventories, analyses of test components by gamma spectrometry and neutron activation showed total releases of 29.6% for ^{85}Kr, 33.1% for ^{137}Cs, 24.7% for ^{129}I, 6.0% for /sup 110m/Ag, and 0.06% for ^{125}Sb. Rubidium and bromine were also detected in the collection system by spark-source mass spectrometry. The fractions released of these chemical analogs of cesium and iodine should have been similar to those obtained for cesium and iodine. Cesium reacted with the oxidized surface in the stainless steel thermal gradient tube; steam oxidation occurred at temperatures $\geq$600°C. Cesium that reacted at ~800°C was considerably more difficult to remove by leaching with simulated "LWR coolant" at 53°C than cesium that reacted or otherwise deposited at ~600°C. The thermal gradient tube deposition profile indicated that iodine probably deposited as cesium iodide. A comparison was made of Cs, I, and Kr release rate coefficients obtained in the HI and HT test series with NUREG-0772 values. The coefficients obtained in the HI tests were factors of 19 and 3.2 times lower than the HT tests and NUREG-0772 values, respectively. 23 refs., 19 figs., 18 tabs.

730 **(NUREG/CR—4156) Operating experience and aging-seismic assessment of electric motors.** Subudhi, M.; Burns, E.L.; Taylor, J.H. (Brookhaven National Lab., Upton, NY (USA)). Jun 1985. Contract AC02-76CH00016. 147p. (BNL-NUREG—51861). NTIS, PC A07/MF A01 - GPO. File Number TI86001324.

Objectives of this program are to identify concerns related to the aging and service wear of equipment operating in nuclear power plants, to assess their possible impact on plant safety, to identify effective inspection surveillance and monitoring methods and to recommend suitable maintenance practices for mitigating aging related concerns and diminish the rate of degradation due to aging and service wear. Motor design and materials of construction are reviewed to identify age-sensitive components. Operational and accidental stressors are determined, and their effect on promoting aging degradation is assessed. Failure modes, mechanisms, and causes have been reviewed from operating experiences and existing data banks. The study has also included consideration for the seismic correlation of age-degraded motor components. The aforementioned reviews and assessments were assimilated to characterize the dielectric, rotational, and mechanical hazards on motor performance and operational readiness. The functional indicators which can be monitored to assess motor component deterioration due to aging or other accidental stressors are identified. Conforming with the NPAR strategy as outlined in the program plan, the study also includes a preliminary discussion of current standards and guides, maintenance programs, and research activities pertaining to nuclear power plant safety-related electric motors.

731 **(NUREG/CR—4166) Analysis of FLECHT-SEASET 163-rod blocked bundle data using COBRA-TF.** Paik, C.Y.; Hochreiter, L.E.; Kelly, J.M.; Kohrt, R.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1985. Contract AC06-76RL01830. 692p. (EPRI-NP—4111; WCAP—10375). NTIS, PC A99/MF A01 - GPO. File Number TI86002085.

Flow blockage and spacer grid heat transfer models for rod bundle arrays have been developed for a two-phase flow situation characteristic of a PWR reflood. These models have been incorporated into COBRA-TF, which is a three-dimensional, three-field, two-fluid mechanistic two-phase flow subchannel computer code. Comparison of the predicted flow blockage heat transfer in large rod bundle arrays with test data indicates that the blockage and grid heat transfer models used with the COBRA-TF code agree quite well with the measured data. Bias plots of the predicted and measured temperature rises from different tests indicate that, in general, the computer code calculatons tend to underpredict the heat transfer improvement observed to have been caused by grids and blockage in the experiments. The principal reason for heat transfer improvement due to blockage and grids is the breakup of the entrained liquid droplets in the superheated steam flow above the quench front. The breakup of these entrained drops results in a population of much smaller drops, which are more easily evaporated in the superheated vapor. The enhanced heat transfer observed in and downstream of blockages and grids is also attribute to increased turbulence caused by the droplets in the steam flow. The resulting computer models and methods of modeling both grids and blockages, which are described in this report, are believed to be applicable to PWR safety analysis. Application of such models is expected to significantly reduce or eliminate the calculted peak clad temperature penalty due to flow blockage for a hypothetical PWR LOCA, using the Appendix K criteria.

732 **(NUREG/CR—4253) Review of TRAC calculations for Calvert Cliffs PTS study.** Jo, J.H.; Rohatgi, U.S. (Los Alamos National Lab., NM (USA); Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1985. Contract AC02-76CH00016. 110p. (BNL-NUREG—51887). NTIS, PC A06/MF A01 - GPO. File Number TI86001106.

Six selected transient calculations out of thirteen performed by LANL using the TRAC-PF1 code for the USNRC PTS study of the Calvert Cliffs Nuclear Power Plant have been reviewed in depth at BNL. Simple hand calculations based on the mass and energy balances have been performed to predict the temperature and pressure of the reactor system, and the results have been compared with those of TRAC. Comparison was also made between the TRAC and RETRAN calculations for two of these transients, which were performed by ENSA. In general, the results calculated by TRAC appear to be reasonable based on the comparison with RETRAN and hand calculations. 2 refs., 33 figs., 9 tabs.

733 **(NUREG/CR—4256) Measurement of response time and detection of degradation in pressure sensor/sensing line systems.** Buchanan, M.E.; Miller, L.F.; Thie, J.A.; Kerlin, T.W.; Ragan, G.E.; March-Leuba, J. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 102p. (ORNL/TM—9574). NTIS, PC A06/MF A01 - GPO; GPO Dep. File Number TI86001474.

A team evaluated several methods for remote measurement of the response time and detection of degradation (blockage or air in lines) of pressure sensor/sensing line systems typical of nuclear power plants. A method was developed for obtaining the response time of force-balance pressure transmitters by briefly interrupting the power supply to the transmitter. The data thus generated are then analyzed in conjunction with a model to predict transmitter response to an actual pressure perturbation. The research team also evaluated a pressure perturbation method for determining the asymptotic delay time of a pressure-sensing line and found that this method yields accurate results for essentially unblocked sensing lines. However, these pressure perturbation tests are not recommended for use in nuclear power plants because they are difficult to implement on-line. A third method for remote measurement applied noise analysis methods that yielded accurate estimates of asymptotic delay times for blockage or air in sensing lines. Even though noise analysis methods worked well in the laboratory, it is recommended that further evaluation be performed in operating nuclear plants.

734 **(NUREG/CR—4257) Inspection, surveillance, and monitoring of electrical equipment inside containment of nuclear power plants, with applications to electrical cables.** Ahmed, S.; Carfagno, S.P.; Toman, G.J. (Franklin Research Center, Philadelphia, PA (USA)). Aug 1985. Contract AC05-84OR21400. 88p. (ORNL/Sub—83-28915/2). NTIS, PC A05/MF A01 - GPO. File Number TI85016827.

The general concepts of equipment condition monitoring as applicable to the detection of age-related deterioration of safety-related equipment are described. The goal is to detect deterioration in the incipient stage, prior to in-service failure and prior to the point at which equipment can no longer be expected to perform its function when exposed to design basis accident conditions. The application of condition monitoring is discussed specifically for electrical cables. The goal of cable condition monitoring is to determine the degree of cable degradation and to predict the remaining useful life. In-situ nondestructive testing and destructive laboratory testing are discussed. Interim recommendations are given for the implementation of a condition monitoring program.

735 **(NUREG/CR—4278) TRAC-PF1/MOD1 developmental assessment.** Sahota, M.S.; Addessio, F.L. (Los Alamos National Lab., NM (USA)). Aug 1985. Contract W-7405-ENG-36. 347p. (LA—10445-MS). NTIS, PC A15/MF A01 - GPO; GPO Dep. File Number TI86001251.

The Transient Reactor Analysis Code (TRAC) is being developed at Los Alamos National Laboratory to provide advanced best-estimate predictions of postulated accidents in light-water reactors. The TRAC-PF1/MOD1 program provides this capability for pressurized water reactors and for many thermal-hydraulic experimental facilities. The code features either a one- or three-dimensional treatment of the pressure vessel and its associated internals; a two-phase, two-fluid, nonequilibrium hydrodynamics model with a noncondensable gas field; flow-regime-dependent constitutive equation treatment; optional reflood-tracking capability for both bottom flood and falling-film quench fronts; and consistent treatment of entire accident sequences from normal operating conditions through severe transients. A new numerical algorithm is used in the one-dimensional hydrodynamics that permits this portion of the fluid dynamics to violate the material Courant condition. This technique permits large time steps and, hence, reduced running time for slow transients. This report presents the results of initial developmental assessment calculations performed with TRAC-PF1/MOD1 before

its public release. The assessment set consists of six integral effects calculations in the Loss-of-Fluid test and Semiscale facilities. Computer run times required to predict each test also are reported.

736 **(NUREG/CR—4305) Comments on the leak-before-break concept for nuclear power plant piping systems.** Rodabaugh, E.C. (Rodabaugh (E.C.) and Associates, Hilliard, OH (USA)). Aug 1985. Contract AC05-84OR21400. 58p. (ORNL/Sub—82-22252/3). NTIS, PC A04/MF A01 - GPO. File Number TI85017406.

The leak-before-break concept is based on the idea that, with a high degree of probability, failure of the pressure boundary of piping systems will be signaled by a detectable leak that will provide ample time to shutdown and repair that leak. The status of the leak-before-break concept is discussed in this report, including a review of industrial and nuclear power plant experience with respect to leak-before-break, fracture mechanics, and potential elimination of postulated pipe breaks in nuclear power plant piping design. 36 refs., 12 figs., 3 tabs.

737 **(NUREG/CR—4325) Parametric study of PWR pressure vessel integrity during overcooling accidents, considering both 2-D and 3-D flaws.** Cheverton, R.D.; Ball, D.G. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 36p. (ORNL/TM—9682). NTIS, PC A03/MF A01 - GPO. File Number TI85016976.

A continuing analysis of the pressurized water reactor pressurized thermal-shock problem indicates that the previously accepted degree of conservatism in the fracture-mechanics model needs to be more closely evaluated and, if excessive, reduced. One feature that was believed to be conservative was the use of two-dimensional as opposed to finite-length flaws. The degree of conservatism could not be adequately investigated because of computational limitations and a lack of knowledge regarding flaw behavior; however, that situation has changed to the extent that some cases involving finite-length flaws can be studied. A flaw of particular interest is one that is located in an axial weld of a plate-type vessel. For those vessels that suffer relatively high radiation damage in the welds, the length of the flaw will be no greater than the length of the weld, and recent calculations indicate that a deep flaw of that length (~2 m) is not effectively infinitely long, contrary to previous thinking. The benefit to be derived from consideration of the 2-m flaw and also a semielliptical flaw with a length-to-depth ratio of 6/1 was investigated by analyzing several postulated transients. In doing so the sensitivity of the benefit to a specified maximum crack-arrest toughness and to the duration of the transient was investigated. Results of the analysis indicate that for some conditions the benefit in using the 2-m flaw is substantial, but it decreases with increasing pressure, and above a certain pressure there may be no benefit, depending on the duration of the transient and the limit on crack-arrest toughness. 22 refs., 11 figs., 3 tabs.

738 **(NUREG/CR—4342) Uncertainty and sensitivity analysis of a model for multicomponent aerosol dynamics.** Helton, J.C.; Iman, R.L.; Johnson, J.D.; Leigh, C.D. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 56p. (SAND—84-1307). NTIS, PC A04/MF A01 - GPO. File Number TI86002067.

An uncertainty and sensitivity analysis of the MAEROS model for multicomponent aerosol dynamics is presented. Analysis techniques based on Latin hypercube sampling and regression analysis are used to study the behavior of a two component aerosol in a nuclear power plant containment for a transient accident with loss of AC power (i.e., a TMLB' accident). Conditional on assumed ranges and distributions for selected independent variables (e.g., initial distributions and mass loadings for each component, temperature, pressure, shape factors), estimates are made for distributions of model predictions and for the independent variables which influence these predictions. The analysis indicated that, for the situation under consideration, variables related to agglomeration (e.g., dynamic shape factor, material density, agglomeration shape factor, and turbulence dissipation rate) tended to dominate the observed variability. For comparison, an analysis based on differential techniques is also given. Further, a study of the effects on MAEROS predictions due to the number of particle size classes and the particle size class boundaries is presented. This analysis was performed as part of a project to develop a new system of computer codes (i.e., the MELCOR code system) for use in risk assessments for nuclear power plants.

739 **(NUREG/CR—4350/2) Probabilistic risk assessment course documentation. Volume 2. Probability and statistics for PRA applications.** Iman, R.L.; Prairie, R.R.; Cramond, W.R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1985. Contract AC04-76DP00789. 278p. (SAND—85-1495/2). NTIS, PC A13/MF A01 - GPO. File Number TI86000096.

This course is intended to provide the necessary probabilistic and statistical skills to perform a PRA. Fundamental background information is reviewed, but the principal purpose is to address specific techniques used in PRAs and to illustrate them with applications. Specific examples and problems are presented for most of the topics.

740 **(NUREG/CR—4350/4) Probabilistic risk assessment course documentation. Volume 4. System reliability and analysis techniques sessions B/C - event trees/fault trees.** Haasl, D.; Young, J. (Institute of Systems Sciences, North Bank, OR (USA); Energy, Inc., Seattle, WA (USA)). Aug 1985. Contract AC04-76DP00789. 144p. (SAND—85-1495/4). NTIS, PC A07/MF A01 - GPO. File Number TI86001857.

This course will employ a combination of lecture material and practical problem solving in order to develop competence and understanding of th principles and techniques of event tree and fault tree analysis. The role of these techniques in the overall context of PRA will be described. The emphasis of this course will be on the basic, traditional methods of event tree and fault tree analysis.

741 **(NUREG/CR—4368) NDE of stainless steel and on-line leak monitoring of LWRs. Semiannual report, October 1984-March 1985.** Kupperman, D.S.; Claytor, T.N.; Mathieson, T.; Prine, D.W. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 37p. (ANL—85-46). NTIS, PC A03/MF A01 - GPO. File Number TI86000230.

An informal workshop on NDE of pipes with weld overlays was held at ANL. Four 60-mm-thick cast stainless steel plates with microstructures ranging from equiaxed to primarily columnar grains have been examined with ultasonic waves. Leaks from a 2-in. ball valve and a flange were studied and compared with leaks from intergranular stress corrosion cracks (IGSCCs) and fatigue cracks. The dependence of acoustic signal on flow rate and frequency for the valve and the flange was comparable to that of fatigue cracks (thermal and mechanical) and different from that of IGSCCs. The GARD/ANL acoustic leak detection system is under evaluation in the laboratory. Results of laboratory tests with simulated acoustic leak signals and acoustic signals from field-induced IGSCCs indicate that cross-correlation techniques can be used to locate the position of a leak.

742 **(NUREG/CR—4376) Heat transfer, carryover and fall back in PWR steam generators during transients.** Liao, L.H.; Parlos, A.; Griffith, P. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1985. 210p. (EPRI-NP—4298). NTIS, PC A10/MF A01 - GPO. File Number TI86900109.

The concern over Pressurized Thermal Shock (PTS), along with many other concerns, indicates the need for accurate knowledge of the steam generator behavior during the blowdown of the steam generator secondary side. To fulfill this need a computer program, SIT-SG (SImulator of Transient in Steam Generator), is developed. This is a one-dimensional best-estimate code with the assumption that the vapor and liquid phases are in thermal equilibrium but not homogeneous. The drift flux model is used to describe the relationship between the vapor and the liquid phase velocity. No momentum equation is required for SIT-SG because the detailed pressure distribution in the vessel is not important for the blowdown process. Based on the comparisons between the code predictions and the data obtained from the experiments conducted in Battelle-Frankfurt and GE, the best drift flux model constants for various flow regimes are selected. SIT-SG has been used to pre-

dict the carryover, fall back, and heat transfer for the MIT steam generator blowdown experiments. The results are encouraging. It is found that the measured dryout front is much higher than the calculated mixture level. If the effective heat transfer area is determined from the mixture level, the primary-to-secondary heat transfer will be substantially underpredicted. From the result of the liquid hold up study we would expect to find two mixture levels, one in the bottom of the steam generator and one above the top tube support plate, provided that flooding occurs at all. 39 refs., 122 figs., 3 tabs.

743 **(NUREG/CR—4383-Rev.7) High pressure ejection of melt from a reactor pressure vessel. The discharge phase. Revision 7.** Pilch, M.; Tarbell, W.M. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 40p. (SAND—85-0012-Rev.7). NTIS, PC A03/MF A01; GPO Dep. File Number DE86001363.

Recent probabilistic risk-assessment studies identified potential accident sequences in which reactor vessel failure occurs while the primary system is at elevated pressure. The phenomenology of the discharge phase is reviewed here. We propose an improved model for hole ablation following vessel failure, and we compare the model with experiment data. Gas blowthrough is identified as a mechanism that allows steam to escape through the vessel breach before melt ejection is complete. Gas blowthrough leads to pneumatic atomization of the remaining melt before significant depressurization of the primary system occurs.

744 **(ORNL/M—98) Post-accident examination of platinum resistance thermometers installed in the TMI-2 reactor.** Carroll, R.M.; Shepard, R.L. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400;AC07-76ID01570. 84p. (GEND-INF—064). NTIS, PC A05/MF A01. File Number TI86001300.

Laboratory tests conducted on one resistance thermometer and thermowell removed from TMI-2 showed that neither its calibration nor its time response was adversely affected by the accident or post-accident conditions to which it had been exposed. No Never-Seez was used in its thermowell. A broken conduit fitting allowed moisture to enter the extension cables, which affected their insulation resistance. Tests on similar thermometers installed in TMI-2 and Crystal River Unit 3 at shutdown and at full power showed that the time response of the TMI-2 thermometer met the 5-second limit required by the plant technical specifications.

745 **(ORNL/TM—1168/R2-Pt.3) Operating manual for the high flux isotope reactor. Operating procedures, Part 3.** (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 241p. NTIS, PC A11/MF A01; GPO Dep. File Number DE86001432.

This volume covers: annunciator procedures, evacuation procedures for operating personnel, emergency operating instructions, abnormal operation instructions, radiation-contamination emergencies, and poison injection system. (DLC)

746 **(PNL-SA—12855) Human factors: a major issue in plant aging.** Widrig, R.D. (Pacific Northwest Labs., Richland, WA (USA)). Jul 1985. Contract AC06-76RL01830. 7p. (CONF-850713—10). NTIS, PC A02/MF A01 - GPO. File Number TI86001641.

From International conference on nuclear power plant aging, availability factor and reliability analysis; San Diego, CA, USA (7 Jul 1985).

Human factors issues will be of great significance in the safe and reliable operation of aging nuclear power plants, and they may be more important than materials/component-type issues. Human actions can accelerate or decelerate te physical aging process. And an aging plant can have significant negative implications on staff performance and actions. Some examples include difficulties in attracting and retaining good managers, financial decisions based on a short and uncertain remaining plant life, difficulties in replacing retiring staff, increased maintenance complexity, and increased burden on training. These problems can be dealt with more effectively by early recognition and a well conceived mitigation effort.

747 **(SAND—85-2131C) Effects of ionizing radiation on the transport chemistry of cesium iodide.** Elrick, R.M.; Powers, D.A. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 21p. (CONF-8509169—1). NTIS, PC A02/MF A01 - GPO. File Number TI86000426.

From Specialist workshop on iodine chemistry in reactor safety organization for economic cooperation and development; Harwell, England (9 Sep 1985).

Mixtures of cesium iodide or silver iodide vapors in steam and hydrogen at 1170K were passed over stainless steel in a radiation field produced by a ^{60}Co source. Cesium iodide and silver iodide were observed to dissociate. The iodine passed through the system. Cesium was found to have bound to oxide layers on the stainless steel. Dissociation of iodide vapors and cesium reaction were not observed in similar experiments done without a radiation field. Thermochemical analyses of the Cs-I-O-H system in the presence of ionizing radiation are presented and used to explain the reactions of cesium iodide.

748 **(WAPD-T—2834) Results of the Light Water Breeder Reactor module drop test.** Wieczorkowski, E.A. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). 1983. Contract AC11-76PN00014. 18p. (CONF-831047—144). NTIS, PC A02/MF A01; GPO Dep. File Number DE85017630.

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

The LWBR core was installed at the Shippingport Atomic Power Station in 1977 and operated from August 1977 to October 1982. Reactivity control was provided by 12 movable fuel modules. Nuclear-poison control rods are not used in the Light Water Breeder Reactor. Power operation of the Light Water Breeder Reactor core at Shippingport was terminated on October 1, 1982, and the Module Drop Test was performed as part of the planned shutdown. This presentation briefly discusses the Module Drop Test procedure, the Module Drop test results, the performance analysis model, and compares the test results to calculations.

749 **Coupled kinetics of grain growth and fission product behavior in nuclear fuel under degraded-core accident conditions.** Rest, J. (Argonne National Lab., IL (USA). Materials Science and Technology Div.). *Journal of Nuclear Materials;* **131**: No. 2/3, 291-302(Apr 1985).

The theoretical FASTGRASS-VFP model has been used in the interpretation of fission gas, iodine, and cesium release from (1) irradiated high-burnup LWR fuel in a flowing steam atmosphere during high-temperature, in-cell heating tests (performed at Oak Ridge National Laboratory) and (2) trace-irradiated LWR fuel during severe-fuel-damage (SFD) tests (performed in the PBF reactor in Idaho). A theory of grain boundary sweeping of gas bubbles has been included within the FASTGRASS-VFP formalism. This theory considers the interaction between the moving grain boundary and two distinct size classes of bubbles, those on grain faces and on grain edges, and provides a means of determining whether gas bubbles are caught up and moved along by a moving grain boundary or whether the grain boundary is only temporarily retarded by the bubbles and then breaks away. In addition, as FASTGRASS-VFP provides for a mechanistic calculation of intra- and intergranular fission product behavior, the coupled calculation between fission gas behavior and grain growth is kinetically comprehensive. Results of the analyses demonstrate that intragranular fission product behavior during both types of tests can be interpreted in terms of a grain-growth/grain-boundary-sweeping mechanism that enhances the flow of fission products from within the grains to the grain boundaries. The effect of fuel oxidation by steam on fission product and grain growth behavior is also considered. The FASTGRASS-VFP predictions, measured release rates from the above tests, and previously published release rates are compared and differences between fission product behavior in trace-irradiated and in high-burnup fuel are highlighted.

750 **Tritiated water measurements with a $^2D(\gamma, n)^1H$ detector.** Winn, W.G.; Baumann, N.P. (E.I. du Pont de Nemours & Company, Savannah River Laboratory, Aiken, South Carolina). *Nuclear Technology;* **64**: No. 3, 300-306(Mar 1984).

Tritiated process water is monitored by detecting the D_2O component via the $^2D(\gamma, n)^1H$ reaction. A probe containing a 1- to 7-mCi ^{24}Na (15-h) gamma source and six ^3He neutron detectors produces and monitors the $^2D(\gamma, n)^1H$ reaction. A variety of probe configurations were examined for D_2O detection sensitivity. The corresponding detection limits range from 6 to 280 μl for D_2O droplets and 1 to 13 μl/cm for D_2O streams, when 10-min neutron counting with a 1-mCi gamma source is used. Results from two field applications illustrate the utility of the monitor.

751 **(NUREG/CR—2331-Vol.1-No.1-2) Safety Research Programs Sponsored by Office of Nuclear Regulatory Research. Quarterly progress report, April 1-June 30, 1981. Volume 1, No. 1-2.** Cerbone, R.J.; Diamond, D.J.; Ginsberg, T.; Guppy, J.G.; Saha, P.; Sastre, C.; Weeks, J.R.; Wulff, W.; van Rooyen, D. (Brookhaven National Lab., Upton, NY (USA)). Aug 1981. Contract AC02-76CH00016. 147p. (BNL-NUREG—51454-Vol.1-No.2). NTIS, PC A07/MF A01 - GPO. File Number TI86000975.

The projects reported are the following: HTGR Safety Evaluation, SSC Code Development, Thermal Hydraulic LWR and LMFBR Safety Experiments, RAMONA-3B Code Modification and Evaluation, LWR Plant Analyzer Development Program, LWR Code Assessment and Application, Stress Corrosion Cracking of PWR Steam Generator Tubing, and Standards for Materials Integrity in LWR's.

752 **(NUREG/TR—0016) Theoretical studies on vapor explosions. 2nd Technical report on Research Project BMFT-RS 76.** Benz, R.; Froehlich, G.; Goldammer, H.; Unger, H; Kottowski, H. (Stuttgart Univ. (Germany, F.R.). Inst. for Nuclear Energy; Nuclear Regulatory Commission, Washington, DC (USA)). Nov 1977. Translation of BMFT-RS 76. 87p. NTIS, PC A05/MF A01 - GPO. File Number TI85901903.

For fuel-coolant-interactions which may lead to vapor explosions, calculations with time-independent methods have been performed in order to make estimations on the upper limits for quasi-static pressures and mechanical energies. In case of fuel-water-reactions, those upper limits with respect to the maximum mechanical energy as well as to the static pressures are higher than in case of fuel-sodium-interactions at corresponding conditions. These time-independent methods, however, are not sufficient in order to predict the course and extent of vapor explosions to any detail. Therefore, additional studies based on simple time-dependent models have been performed. A more accurate description of the occurrence and course of vapor explosions is only possible by means of an improved knowledge of the details of the mechanism of fragmentation. For this reason, the development of several fragmentation models has been started. The most advanced development has been achieved in case of a model which describes the increase of the surface of the molten fuel caused by the energy which has been released during the collapse of vapor bubbles. The results of this model are sufficient for a qualitatively correct description of the experimentally observed correlations. In order to calculate the thermohydraulic behavior during a fuel-coolant interaction in a channel, an advanced model applicable to channel geometry is introduced; for fuel-coolant interactions in tank geometry, such a model has yet to be developed.

25 ENERGY STORAGE

2501 Magnetic

753 **(LA-UR—85-3195) Design and cost of a utility scale superconducting magnetic energy storage plant.** Loyd, R.J.; Nakamura, T.; Schoenung, S.M.; Lieurance, D.W.; Hilal, M.A.; Rogers, J.D.; Purcell, J.R.; Hassenzahl, W.V. (Bechtel, Inc., San Francisco, CA (USA); General Dynamics Corp., San Diego, CA (USA); Los Alamos National Lab., NM (USA); GA Technologies, Inc., San Diego, CA (USA); Lawrence Berkeley Lab., CA (USA)). 1985. Contract W-7405-ENG-36. 9p. (CONF-850814—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000777.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

Superconducting Magnetic Energy Storage (SMES) has potential as a viable technology for use in electric utility load leveling. The advantage of SMES over other energy storage technologies is its high net roundtrip energy efficiency. This paper reports the major features and costs of a jointly developed 5000 MWh SMES plant design.

754 **(LA-UR—85-3196) Liquid helium dump concept for a large scale superconducting magnetic energy storage plant.** Schoenung, S.M.; Loyd, R.J.; Nakamura, T.; Rogers, J.D.; Purcell, J.R. (Bechtel, Inc., San Francisco, CA (USA); Los Alamos National Lab., NM (USA); GA Technologies, Inc., San Diego, CA (USA)). 1985. Contract W-7405-ENG-36. 9p. (CONF-850814—23). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000776.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

Superconducting Magnetic Energy Storage (SMES) is a potentially cost effective technology for electric utility load leveling. Design concepts and cost estimates of SMES plants capable of delivering 5000 MWh daily have been previously identified. An important feature of a large commercial plant is a system that will reliably shut down the magnet by thermally dissipating the stored energy in the event of an imminent or actual loss of superconductivity. To prevent damage to the coil during such a protective energy dump, the entire coil must be driven "normal", i.e., resistive rather than superconducting, in a short period of time. This requires rapid removal of the liquid helium coolant surrounding the coil. This paper describes a simple system that has been developed to rapidly remove the liquid helium from the helium vessel. The system requires only a small number of active components, no external helium storage, and is practical to reset and maintain.

2506 Thermal

REFER ALSO TO CITATION(S) 417, 418, 419, 850

755 **(AVESTA-PROJ—1984-2) Physiological measurements on divers in hot water stores.** Skoeldstroem, B.; Radway, T. (Swedish State Power Board, Vaellingby). 1984. 10p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752731.

The recommendations made by the National Swedish Board of Occupational Safety for diving in hot water have been tested. A series of physiological measurements were made on the divers during the inspection of a hot water reservoir. Heart frequency, body and skin temperature of divers working in 34 degreeC warm water at a maximum depth of 22 m were continuously measured. The investigation showed that the recommended diving time was right and the protective clothing, an ice filled jacket, could be used so that the body temperature would not exceed 39 degreeC.

756 **(AVESTA-PROJ—1984-3) Instrumentation for the hydrogeological investigation programme.** Fogdestam, B.; Olsson, T.; Saernblad, L. (Swedish State Power Board, Vaellingby). Feb 1984. 25p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752730.

The groundwater measurements during the operation stage are mainly included in an automatic data aquisition system, designed for the thermal investigations of the water in the rock cavern. For the hydrogeological investigations, eight boreholes were equiped with packers, pressure transducers, and temperature gauges. Five of these boreholes were drilled from the ground surface above and around the cavern, while three are located in an especially prepared tunnel. This report presents the measuring system and the equipment installed in the boreholes. Included is also a preliminary review of the experiences of the system. At the beginning, great prolems arose regarding the watertightness of the transducers and gauges, due to flaws in the connection between the electronic parts and the steel shielded cable. Most pressure transducers and temperature gauges were however reconstructed, after which they operated properly.

2509 Batteries

REFER ALSO TO CITATION(S) 1024, 1079

757 **(AD-A—155223/1/XAB) Safe, high-power-density lithium battery. Final report, September 1984-February 1985.** Walsh, F. (ECO Energy Conversion, Newton, MA (USA)). Mar 1985. 27p. NTIS, PC A03/MF A01.

The Li/SOC12 battery has received attention because of its high theoretical energy/power density. However, practical Li/SOC12 cells have not provided the desired power density and have suffered from concerns with cell safety on discharge. In previous work, ECO has shown that the use of a TAA-type catalyst significantly improves the safety of the Li/S0C12 cell at high rate. The objective of this Phase I program was to determne whether a stacked-diak electrode configuration with TAA-catalyzed cathodes would meet a high power-density design goal. Under the program, the effects of cathode thickness, preparation pressure, electrolyte gap, and solute concentration on stacked-electrode cell performance and capacity were measured. The results of the Phase I program included the demonstration of stacked-electrode cell performance and capacity at levels suitable to meet a design goal of 400 W/kg with high energy density. Further work in a Phase II program will be required to demonstrate in laser-sealed fully-packaged cells that the results of Phase I can be practically applied to provide a safe high-rate, energy-dense power source for military applications.

758 **(AD-A—155733/9/XAB) Safety characteristics of non-lithium battery systems. Final report for period ending FY84.** Murphy, R.M.; Bis, R.F. (Advanced Battery Group, Lancaster, NY (USA)). Jul 1984. 324p. NTIS, PC A14/MF A01.

A study was conducted to determine the safety characteristics for both primary and secondary non-lithium battery systems. Of particular interest was the behavior of these battery systems when subjected to the electrical and thermal-abuse testing procedures of NAVSEAINST 9310.1A (i.e., short circuit, forced overdischarge, and incineration). Also included are the safety/hazard characteristics associated with charging primary batteries and overcharging secondary batteries. This report also summarizes the manufacture, electrical performance, failure mechanisms, self-discharge, and applications for twenty-two primary and nineteen secondary battery systems.

759 **Effects of phosphoric acid concentration on oxygen reduction kinetics at platinum.** Hsueh, K.L.; Chin, D.T.; Gonzalez, E.R.; Srinivasan, S. (Los Alamos National Laboratory, Los Alamos, NM). *Journal of the Electrochemical Society;* **131**: No. 4, 823-828(Apr 1984).

The oxygen reduction reaction was investigated at platinum electrodes in phosphoric acid in the concentration range 0.7M(6.6%) to 17.5M(95%) at 25°C using the rotating ring-disk electrode technique. As a complement, cyclic voltammograms on platinum and potentials of zero charge of mercury were obtained as a function of phosphoric aci concentration. The mechaniam of the oxygen electrode reaction is discussed in terms of the direct four-electron transfer reduction to water and the formation of hydrogen peroxide as an intermediate in a parallel two-electron transfer reaction The rate constants of the intermediate reaction steps were calculated from the ring-diak data for various potentials and electrolyte concentrations. The characteristics of the reaction were found to be markedly dependent on the concentration of phosphoric acid. These results are interpreted in terms of changes in oxygen solubility, proton activity, and double laye characteristics when passing over from a water to a phosphoric acid solvent structure.

760 **Relationships among electrochemical, thermodynamic, and oxygen potential quantities in lithium-transition metal-oxygen molten salt cells.** Godshall, N.A.; Huggins, R.A.; Raistrick, I.D. (Department of Materials Science and Engineering, Stanford University, Stanford, California). *Journal of the Electrochemical Society;* **131**: No. 3, 543-549(Mar 1984).

The interdependence of thermodynamic parameters, phase equilibria, and electrochemical measurements can be used as a powerful tool in the development of high specific energy cells. These principles were used in the analysis of electrochemical experiments performed on ternary lithium-transition metal-oxide (M = Mn, Fe, and Co) positive electrodes. The free energies of formation of $LiMnO_2$, Li_5FeO_4, $LiFeO_2$, and $LiCoO_2$ were found to be -178.21, -399.88, -154.18, and 131.62 kcal/mol at 400°C. The electrochemical displacement reactions were found to be reversible in LiCl/KCl molten salt cells over a range of 0.0-3.0 Li equivalents per mol at current densities of 5-15 mA/cm^2. The equilibrium potential vs. Li was found to be a logarithmic function of the calculated oxygen partial pressure for any tie triangle in which Li_2O is present, or for any tie triangle containing ternary oxide phases Li /SUB x/ MO / SUB y/ which are only marginally stable with respec to Li_2O and the relevant binary oxides MO /SUB y/ . Compounds with oxygen partial pressures above 10^{-25} atm were found to be unstable in LiCl/KCl electrolyte at 400°C.

761 **EMF measurements on the Li-Al/Ni_3S_2 couple in molten salt electrolytes.** Tomczuk, Z.; Redey, L.; Vissers, D.R. (Argonne National Laboratory, Chemical Technology Division, Argonne, Illinois). *Journal of the Electrochemical Society;* **130**: No. 5, 1075-1077(May 1983).

The (emf) vs. temperature curve for the Li-Al/Ni_3S_2 couple was determined in 58.2 mol percen (m/o) LiCl-41.8 m/o KCl (eutectic electrolyte), 49.1 m/o LiCl-50.9 m/o KCl (KCl-rich electrolyte), 69.6 m/o LiCl-30.4 m/o KCl (LiCl-rich electrolyte), and in 22 m/o Lif-31 m/o LiCl-47 m/o LiBr electrolyte. The results indicate that with these electrolytes the emf value of the couple at a given temperature is independent of the electrolyte composition. Equilibrium emf values were obtained instantaneously upon heating or cooling at rates of about0.2°C/min, while at higher rates (about0.5°C/ min) equilibrium values were obtained after about 1 1/2 hr at a given temperature. X-ray diffraction analyses of the positive electrodes from the cells tested indicate that the only nickel-sulfur phase formed in the electrode reaction is Ni_3S_2. Thermochemical analyses also suggest Ni_3S_2 as the active nickel sulfide phase.

29 ENERGY PLANNING AND POLICY

762 **(DOE/OR/20948—T1) EIA/state workshops, February-March 1982. Summary report.** (New Mexico Energy and Minerals Dept., Santa Fe (USA)). 15 Apr 1982. Contract AC05-82OR20948. 1045p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85013510.

This report summarizes particulars pertaining to the EIA/State Energy Information Workshops sponsored by the US Energy Information Administration (EIA) during the second quarter of fiscal year 1982. Workshop discussions demonstrated the broad range of interests and priorities at State level, understandably reflecting the differing reaponsibilities and resources of the participating states. In all workshops, however, there was a discernible consensus that EIA should continue to serve as the national focal point for the collection, processing, and dissemination of energy data. Complete transcripts of workshop discussions are included in this report as Appendices B through F. An index to workshop transcripts is provided in Appendix G.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 775, 815

763 **(DOE/CE/40732—T1) Industrial energy management: leveraging a national effort for increasing industrial energy management technology. Quarterly status report, July 1, 1985-September 30, 1985.** (ACEC Research and Management Foundation, Washington, DC (USA)). 1985. Contract FG01-85CE40732. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001105.

The Management Plan has been completed and submitted to DOE for their review. This plan contains an introduction, management approach, work task descriptions, project work schedules shown on GAMTT diagrams, and a budget allocation breakdown and graph. Industrial market and energy management guides will be prepared for each of the following industries: stone, clay, and glass products; fabricated metal products; and machinery, except electrical products.

784 **(DOE/EIA—0480) United States energy balance. Procedures for International Energy Agency submission.** Brooks, H.S. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 23 Oct 1985. 178p. NTIS, PC A09/MF A01; 1 - GPO; GPO Dep. File Number DE86001922.

This report describes the process of constructing the US energy balance and describes how the US data are derived. The energy balance is constructed on forms included in the annual questionnaire circulated among member countries of the International Energy Agency (IEA). The Energy Information Administration (EIA) also completes a set of fuel specific annual forms. Energy balances in general are discussed. The various forms and instructions that are part of the IEA annual reporting structure are presented. The three annual OECD fuel questionnaires are discussed next, followed by a short section on conversion factors. All the preceding is preparation for the main part of the report, calculating the balance. The energy balances for the various fuels are calculated separately. 10 refs., 4 figs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 109, 113, 117, 118, 126, 128, 129, 130, 132, 270, 273, 274, 453, 801, 846, 1356

765 **(DOE/SF/11603—T1) Developing a high school level course in appropriate technology. Final report.** Sussman, A.J. (Sussman (Arthur J.), Point Arena, CA (USA)). 15 Sep 1983. Contract FG03-81SF11603. 12p. Arthur J. Suosman, Box 549, Point Arena, CA. File Number TI86001140.

This grant project aimed to develop high school level educational materials regarding appropriate energy technology. The primary result of this project was the writing of the text Energy for Everyone (Appendix A). This book can be used for teacher and student reference as well as a standard text for an energy science course. To supplement the text, an experiments and projects book (Appendix B) has been partially completed.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 459, 460, 1302, 1318, 1342, 1343

766 **(CONF-851123—2) Potential advantages and pitfalls in determining cost-effective emission control strategies to reduce acid deposition.** Streets, D.G. (Argonne National Lab., IL (USA)). Nov 1985. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001794.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

The advantages and disadvantages of various cost-effective strategies for acid rain control are discussed in comparison with the approaches taken in current congressional proposals: Aspin; Stafford; Udall-Cheny I and II; Sikorski-Waxman; Amended Stafford; and D'Amours. (PSB)

767 **(DOE/BP—515) Environment and power: BPA begins EIS on power sales contracts.** (USDOE Bonneville Power Administration, Portland, OR). Aug 1985. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002017.

The environmental impact of power sales contracts are being examined. Some of the issues involved are discussed. Public meetings will be held. (DLC)

2904 Natural Resources

768 **(K/PS—1123) Cooling tower drift studies at ORGDP. Final report.** Park, S.H.; Taylor, F.G. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jul 1985. Contract AC05-84OT21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85018438.

During the 1970s, a major consideration in environmental impact studies of electric power plant operations was the effects of cooling tower drift. In 1973 the distribution and magnitude of drift from mechanical draft cooling towers at the Oak Ridge Gaseous Diffusion Plant (ORGDP), Oak Ridge, Tennessee, was investigated (Taylor et al., 1975). That study provided evidence of the transport and deposition of drift to the terrestrial environment, but only depicted a single season from over three decades of continuous operation. Results of that study suggested that increased quantities of trace elements (chromium) in vegetation attained an equilibrium concentration with environmental losses (weathering, leaching) compensated by chronic deposition. The cooling towers investigated in the 1973 study were built in the early 1950s, but were constantly remodeled and upgraded over this time period. However, 0.03% to 0.1% drift percentage obtained in the 1973 study (Jallouk et al., 1974) was considerably higher than some of similar towers constructed later. The ORGDP diffusion process production rate is varied by changing the operating power level of the plant which, in turn, is related to the recirculating cooling water (RCW) flow rate. Drift fraction is a function of the RCW flow, such that variations (seasonal) in plant operation influence drift emissions.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 91, 130, 786, 787, 788, 789, 852, 1011

769 (INIS-mf—9910-Vol.1, pp 55-68) **Nuclear analysis group (GAN). Another initiative of the Ecole Polytechnique for service to industry.** Rozon, D. (Ecole Polytechnique, Montreal, Quebec (Canada)). 1983. (In French). NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

In 1970, the Ecole Polytechnique founded an institute of nuclear engineering, l'Institut de Genie Nucleaire (IGN), with an initial mandate to offer a Master's degree in nuclear engineering. Mention should be made also of the installation of the Slowpoke reactor in 1976, the creation the next year of a radiochemistry laboratory, and the launching of a Ph.D. programme in nuclear engineering in 1979. Throughout this period, the professors and researchers of the IGN were able to benefit from financial support in the form of grants and research capital from important organizations in the Canadian nuclear community. The creation, in June 1981, of the Nuclear Analysis Group (Groupe d'Analyse Nucleaire) is another manifestation of this attitude. This is an important step in the development of the IGN.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 163, 164, 475, 532, 1356

770 **(NP—5902153) Proliferation resistant nuclear power technologies: preferred alternatives to the plutonium breeder.** Cochran, T.B.; Train, R.E.; von Hippel, F.; Williams, R.H. (LMFBR Review Steering Committee (USA)). 6 Apr 1977. 54p. NTIS, PC A04/MF A01. File Number DE85902153.

Acceptability for the commercialization of an energy supply alternative must show that the utilization of the technology by a non-nuclear weapons state leaves that state no closer to a nuclear weapons capability than the use of low-enriched uranium fueled reactors in a once-through fuel cycle mode. The plutonium breeder and its associated fuel cycle does not meet this minimum criterion. It is believed that termination of the CRBR project and all other activities associated with the plutonium economy is essential if the US is to have credibility in its efforts to prevent nuclear weapons proliferation. Making fast breeder reactors inherently proliferation resistant may be intractable. Fast breeder reactors are tied to fuel cycles which contain nuclear weapons useable material in the fresh fuel of a significant fraction of all reactors. To show that there exist alternative uranium conserving fuel cycles that are much more proliferation resistant than the plutonium fuel cycle, attention is given to the denatured uranium-thorium fuel cycle. The high end of the electricity demand forecasts considered by ERDA's Task Force on the "Fission Breeder - Why and When" is based on wholly unrealistic expectations of future electricity prices. Energy growth at or near historical rates can be achieved only by continued energy waste. Such energy waste would undermine rather than strenghten US security. By the year 2010 the US GNP could be doubled with only a 40% increase in energy use. It is difficult to project a growth rate for electricity averaging more than 3% per annum out to the year 2000. The viability of relying on proliferation resistant uranium conserving reactors requires a plateauing of nuclear generating capacity early in the next century.

771 **(NUREG—0020-Vol.9-No.8) Licensed operating reactors. Status summary report: data as of July 31, 1985. Volume 9, No. 8.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Sep 1985. 446p. NTIS, PC A19/MF A01 - GPO. File Number TI86900124.

This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Head-quarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capabilitiy, reactor years of experience and non-power reactors in the United States.

772 **(ORNL/TM—9692) Evacuation decision-making: process and uncertainty.** Mileti, D.; Sorensen, J.; Bogard, W. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001466.

The purpose was to describe the processes of evacuation decision-making, identify and document uncertainties in that process and discuss implications for federal assumption of liability for precautionary evacuations at nuclear facilities under the Price-Anderson Act. Four major categories of uncertainty are identified concerning the interpretation of hazard, communication problems, perceived impacts of evacuation decisions and exogenous influences. Over 40 historical accounts are reviewed and cases of these uncertainties are documented. The major findings are that all levels of government, including federal agencies experience uncertainties in some evacuation situations. Second, private sector organizations are subject to uncertainties at a variety of decision points. Third, uncertainties documented in the historical record have provided the grounds for liability although few legal actions have ensued. Finally it is concluded that if liability for evacuations is assumed by the federal government, the concept of a "precautionary" evacuation is not useful in establishing criteria for that assumption. 55 refs., 1 fig., 4 tabs.

773 **(PB—85-211266/XAB) Nuclear arms control: background and issues.** (National Research Council, Washington, DC (USA)). 1985. 388p. NTIS, PC A17/MF A01.

This book reviews the history and status of various arms control negotiations and proposals and details the critical issues that must be resolved before progress in arms control can be made. The book contains no conclusions or recommendations, but rather discusses the reasons behind both the United States and the Soviet Union's current positions on arms control. It covers the full range of arms control: nuclear force negotiations, the anti-ballistic missile treaty and strategic defense, control of arms in space, nuclear test bans, and efforts to prevent the spread of nuclear weapons to additional countries.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 845

2910 Conservation

REFER ALSO TO CITATION(S) 781, 784, 819, 824

774 **(DOE/CE/29999—T1) Energy conservation multi-year plan, FY 1987.** (Energetics, Inc., Columbia, MD (USA)). Jul 1985. Contract AC01-85CE29999. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86001703.

Chapter 2.0, on the Planning Context and Methodology, places energy conservation in the larger context of national energy policy and strategic objectives, discusses global trends in energy supply and economic developments relevant to program planning decisions, establishes certain policy guidance for portfolio planning, and outlines the methodology and assumptions used in the technical assessment of R and D needs and program priorities. While each Office performs its own independent assessments, common terms of reference are provided as to appropriate project evaluation considerations, quantitative energy-related measures, and the desire to incorporate private sector inputs explicitly in the planning process. Chapters 3.0 through 6.0 present the technical assessments themselves for each sector: the residential and commercial buildings program, transportation program, industrial program, and energy systems research programs (energy conversion and utilization technology, electric energy systems, and energy storage).

775 **(NP—6900148) Bayard energy study. Nebraska community energy management program.** (Nebraska Energy Office, Lincoln (USA)). 1983. 31p. Nebraska Energy Office, Box 95085, Lincoln, NE 68509. File Number TI86900148.

A data analysis was conducted on energy used in Bayard, Nebraska. The results will be used by the community to devise methods for minimizing energy consumption. With the help of the Nebraska Energy Office, a comprehensive energy management plan will be developed for the community. The financial advantages for energy conserving plans are summarized in graphs and charts.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 107, 117, 118, 125, 129, 130, 132, 163, 275, 764, 781, 801

776 **(CEER-X—160) Problems and possibilities in the development of a Caribbean Basin energy program.** Koehler, W.C. Jr. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Political Science; Puerto Rico Univ., San Juan. Center for Energy and Environment Research). Dec 1982. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000065.

This report is concerned with the role that various organizations, universities and research institutes might assume in developing programs to assist nations in the Caribbean Basin. It considers implementation problems each may encounter as it seeks to expand its role in technology transfer and the development of energy programs and policies. The report is neither prescriptive nor proscriptive, but seeks to: (1) map the range of problems; (2) identify the key actors; and (3) consider possible approaches. Given the re-

source and time constraints on the development of this study, the recommendations incorporated herein should not be considered exhaustive, but merely as points of departure.

777 **(DOE/EIA—0202(85/3Q)2) Short-term energy outlook: methodology.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Jul 1985. 89p. NTIS, PC A05/MF A01 - GPO; GPO Dep. File Number DE86001828.

Volume 2 of the "Short-Term Energy Outlook (Outlook)" is published periodically as a supplement to Volume 1 of the "Outlook", which is published quarterly. The July 1985 "Outlook", volume 1, presented projections of energy production, demand, inventories, and prices through 1986. The second chapter of this volume reviews some of the analytical techniques used to prepare those forecasts. The chapters in this report are independent, so that specific information can be obtained without reading the entire volume. A brief description of each chapter is given below: Chapter 2 - Discusses recent changes in the forecasting methodology; Chapter 3 - Evaluates the accuracy of previous short-term energy forecasts and the major assumptions underlying these forecasts published in the last 13 issues of the "Outlook"; Chapter 4 - Evaluates the accuracy of the models with simulations usig the correct values for the independent variables; Chapter 5 - Presents a comparison of recent energy forecasts for 1985; Chapter 6 - Presents the results of an analysis of electricity demand between 1953 and 1983, with emphasis on the effects of structural change on price and income elasticities; and Chapter 7 - Discusses a method for projecting energy supply components simultaneously in the Short-Term Integrated Forecasting System (STIFS). Examples compare this method with the current STIFS integrating methodology. 8 refs., 3 figs., 54 tabs.

778 **(DOE/OR/21400—T179) Review of recent demand/supply projections.** (Donovan, Hamester and Rattien, Inc., Washington, DC (USA)). 19 Jul 1977. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85018260.

The purpose of this study is to assess the often conflicting viewpoints on projected energy demand levels, with a particular emphasis on the assumptions which underlie the demand pictures postulated by Lovins, von Hippel and Williams, and Weinberg and Whittle (IEA). A knowledge of these assumptions takes us a long way in understanding the real potential for the low energy demand levels projected as well as the critical biases which may be inherent in the various arguments. It also requires assessing some of the possible difficulties, be they technical, environmental, economic, social or institutional, which have perhaps not been fully anticipated by advocates of a rapid implementation of the "soft" energy technologies designed to achieve major efficiency increases. Cognizant of the philosophically-based differences of opinion which have surfaced in the debate, the reader will be better able to objectively assess differing perspectives of what future energy demands might turn out to be and how they might best be supplied recognizing the various constraints imposed by resource availability, the current status of technology, environmental protection requirements and the institutional setting in which energy is produced and delivered.

779 **(DOE/PE/77015—T1) Keystone energy futures project. Phase I. Final technical report.** (Keystone Center, CO (USA)). Sep 1985. Contract FG01-85PE77015. 95p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001311.

US energy futures were reviewed and critical energy issues in need of more constructive dialogue and national attention were identified. Through a series of formal presentations and plenary and small group discussions, participants engaged in discussions and reached consensus views regarding: National Energy Policy goals; views about energy futures; and identification of critical energy issues.

780 **(PB—85-214245/XAB) U.S. energy for the rest of the century: 1985 edition. Annual report.** Gustaferro, J.F. (International Trade Administration, Washington, DC (USA)). 2 Jul 1985. 71p. NTIS, PC A04/MF A01.

The report presents U.S. energy consumption and supply for two years, 1984 and 2000. In 1984, the United States consumed about 73.7 quadrillion British thermal units of energy. The report projects a U.S. energy consumption of about 84 quadrillion British thermal units in the year 2000. The 84 quadrillion British thermal units consists of 13 million barrels per day of petroleum, 18 trillion cubic feet of natural gas and 3.5 trillion kilowatt hours of electricity. Coal production is projected at 1,405 million tons which includes exports. The data presented in the 1985 forecast cover the spectrum of U.S. energy requirements and focus on the end use of energy for operational purposes, e.g., highway transportation, space heating, lighting, and construction. The report's tables provide data on fuel consumption by types and energy content for 1984 and as projected for the year 2000. End users of energy in the United States currently spend $454 billion annually for energy. This includes direct taxes.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 532, 766

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 86, 86, 87, 107, 108, 109, 113, 113, 117, 118, 125, 126, 127, 128, 129, 130, 132, 801, 846

781 **Rapporteur: Efficient utilization.** Rosenberg, R.B. (Gas Research Inst.). pp 1145-1150 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

This paper examines the belief that high efficiency is necessary in gas utilization if the natural gas industry is to stay competitive. The need to understand the consumer and the market as focal points of research and development activities is emphasized.

2960 Electric Power

REFER ALSO TO CITATION(S) 108, 293, 453, 459, 463, 464, 767

782 **(DOE/EIA—0226(85/07)) Electric Power Monthly, July 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 15 Oct 1985. 44p. NTIS, PC A03/MF A01 - GPO; GPO Dep. File Number DE86001693.

During July 1985, net generation by electric utilities in the United States was 226,712 gigawatthours. On a year-to-date basis, net generation at the end of July 1985 was 1.6% higher than for the same period in 1984. In July 1985, coal accounted for 56.8% of all electricity produced, petroleum for 3.7%, gas for 14.2%, hydroelectric power for 9.4%, nuclear power for 15.5%, with the remaining 0.4% from geothermal, wood, wind, waste, and solar. In July 1985, electric utilities consumed 64,274 thousand short tons of coal. Petroleum consumption in July 1985 was 14,347 thousand barrels, while gas consumption was 335,185 million cubic feet. On a year-to-date basis, coal consumption at the end of July 1985 was 5.1% higher than that for the same period in 1984; petroleum consumption was 21.5% lower than during the same period in 1984; and gas consumption was 1.3% lower.

783 **(EPRI/EA/EL—4266) Mixture of normals approximation of equivalent load duration curves. Final report.** Gross, G. (Pacific Gas and Electric Co., San Francisco, CA (USA)). Oct 1985. 112p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920021.

A new method of approximating equivalent load duration curves can help utilities assess the costs associated with power plant expansions. Fast, accurate, and versatile, this technique greatly reduces the number of calculations needed to quantify the effects of customer load demand and unscheduled generator outages on system performance.

784 **(OA-Trans—2757) Electricity: the driving force behind the reduction in the energy content of the GNP.** Felix, F. Translated from *Revue de l'Energie ;* No. 370, 17-21(Jan 1985). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85902132.

This report analyzes the effect of increased penetration of electricity in fossil-fuel substitution on the gross national product of six industrialized countries (USA, FRG, France, Japan, Italy and UK), with particular reference to the USA. The analysis is based on the definition and quantification of a "substitution coefficient" which records the ratio of the number of therms from fossil-fuel sources which can be replaced by one kWh. 4 figs., 1 tab.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 108, 780

785 **(DOE/EIA—0035(85/07)) Monthly Energy Review, July 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 28 Oct 1985. 124p. NTIS, PC A06/MF A01 - GPO; GPO Dep. File Number DE86002467.

Current data on US production, consumption, stocks, imports, exports, and prices of principal energy commodities are reported for each month of 1983 through the most recent month of 1985, and for each year from 1973 through 1982. Quarterly summaries for the current year are also provided. Energy sources covered are crude oil, petroleum products, natural gas, coal, nuclear power, and electric utilities. Also reported are energy consumption by sector, selected energy indicators, and oil and gas resource development. For selected other countries in the world, production, consumption, and stocks of petroleum and electricity generation by nuclear power plants are presented. Conversion factors and a glossary are provided, along with feature articles on current energy topics.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 273, 274, 275

786 **(DOE/CS/40381—T1) Energy integrated farm systems program DOE/USDA. Final report, Fall of 1980-March 31, 1984.** Olver, E.F. (Department of Agriculture, Beltsville, MD (USA)). 1984. Contract AI01-80CS40381. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001701.

Very brief descriptions of 7 energy integrated farm projects in Arizona, Nebraska, Texas, Georgia, New York, North Dakota, and Puerto Rico are presented. The projects include irrigation, solar collectors, green houses, alcohol production, biogas, on-site power generation, and waste heat utilization. (DMC)

787 **(DOE/OR/21390—7) Great Lakes Regional Biomass Energy Program. Quarterly report, December 1, 1984-February 28, 1985.** (Council of Great Lakes Governors, Inc., Madison, WI (USA)). 1985. Contract FG05-83OR21390. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001949.

This report covers activities under the Great Lakes Regional Biomass Energy Program for the period December 1, 1984 through February 28, 1985. The program is intended to provide resources to public and private organizations in the Great Lakes region (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin) to increase the utilization and production of biomass fuels. During this quarter, the contract with the Fiber Fuels Institute to develop fuel specifications was closed-out. The project is the first step in providing biomass fuel users with comprehensive data on solid biomass fuels. Four publications were also released this quarter: (1) Directory of Great Lakes Regional Biomass Energy Facilities; (2) Wood Heating; (3) Directory of Biomass Combustion Systems 250,000 to 10,000,000 Btu/h Output; and (4) Residential Wood Combustion Emissions and Safety Guidebook. A meeting of the program Technical Advisory Committee (TAC) was held in Chicago to discuss issues and barriers to biomass energy development in the Great Lakes region. The TAC was divided into eight working groups to focus on various biomass feedstocks and conversion processes. The results of the meeting will be presented to the Steering Council during the next quarter as part of the long-range planning process.

788 **(DOE/OR/21390—8) Great Lakes Regional Biomass Energy Program. Quarterly report, March 1-May 31, 1985.** (Council of Great Lakes Governors, Inc., Madison, WI (USA)). 1985. Contract FG05-83OR21390. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001948.

This report covers activities for the period March 1, 1985 through May 31, 1985. The program is intended to provide resources to public and private organizations in the Great Lakes region (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin) to increase the utilization and production of biomass fuels. Under the state grant program this quarter, the State of Michigan solicited sixty firms to identify which ones would be interested in having wood energy feasibility analyses performed on their facilities. The State of Wisconsin performed 13 such analyses during the last quarter for firms and institutions in the southern two-thirds of the state. Emissions testing of a wood-fired heating system was completed by the State of Minnesota. The State of Iowa awarded five subcontracts to examine municipal waste/short rotation forestry and conventional wood residues for energy. Small Business Innovators submitted a draft slide show on the use of municipal waste for energy as part of its overall technology transfer contract. A landowner questionnaire designed to test the attitudes of farmers toward growing short rotation trees, herbaceous crops and collecting agricultural residues on marginal land was developed by the University of Illinois. Employment Research Associates defined a computer program to estimate the employment and tax implications of increased biomass use in the seven state Great Lakes region. A brochure describing the structure and functions of the Great Lakes Regional Biomass Energy Program was developed and printed. Great strides were made this quarter in scoping down the focus of the Great Lakes program. Attachments to this report include the Technical Advisory Committee's report on issues and barriers to biomass energy development in the Great Lakes Region.

789 **(DOE/R1/23281—T1) Integrated agricultural energy system.** Taylor, R.M. (Taylor (Robert M.), Boston, MA (USA)). [1985]. Contract FG41-81R123281. 3p. (MA—81-002). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000508.

The purpose of this program is to show New England farmers and other New England energy users how they can use alternative energy sources to reduce their energy cost and dependency on conventional sources. The project demonstrates alternative energy technologies in solar, alcohol and methane. Dissemination is planned through tours to be conducted by the Worcester County Extension Service. Most of these goals were completed as planned. A few things have yet to be completed. The solar panels and solar hot water tanks have to be installed. The fermenter's agitating and cooling system have to be secured inside the fermenter. Once these items are complete tours will begin early in the spring.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

790 **(DOE/ET/10815—107) Theoretical studies of recirculating duct flows for the UTSI MHD combustor design.** Lee, J.J.; Schulz, R.J.; Scott, M.A. (Tennessee Univ., Tullahoma (USA). Space Inst.). Sep 1985. Contract AC02-79ET10815. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86000695.

A theoretical investigation of duct flows is reported that is an extension of previous work with heat transfer and a more complex geometry considered. The program developed is general and is capable of predicting recirculating turbulent flow in either a two-dimensional Cartesian or an axisymmetric coordinate system. This is accomplished through definition of the stream function using the classic Von Mises transformation and the restructuring of the component Navier-Stokes equations into the governing equations for transport of vorticity. Such a technique is standard in computation-

al fluid dynamics and provides a powerful means of analyzing recirculating flows wherein the explicit dependency of the flow upon pressure is eliminated. An iterative, general finite-difference solution procedure suitable for two-dimensional elliptic flows in complex geometries is then used to solve the nonlinear partial-differential equations. The program computes the following variables in the region of interest: stream function and vorticity; axial, radial, and swirl velocity components; poressure, density and temperature; turbulent kinetic energy and its dissipation rates; axial and radial heat transfer rates. The objective of the present document is to present details of the computational solution procedure and to provide a qualitative understanding of the effects of the flow Reynolds number, the core jet width, the duct angle, the swirl velocity, the turbulent intensity and the jet position. 6 refs., 50 figs., 2 tabs.

791 (DOE/ET/15602—T16) **MHD air heater technology development. Technical progress report, October 1, 1980-September 30, 1981.** (FluiDyne Engineering Corp., Minneapolis, MN (USA)). Mar 1982. Contract AC22-80ET15602. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86000992.

Selection of materials for use in both the VTF and MTF continued. Materials were selected for modifications to the VTF hot gas supply duct and for planned modifications to the MTF. Efforts to identify and locate sources of fusion cast and other spinel materials were continued. Results of analyses of materials tested in the MTF were also obtained. Work was continued in defining HTAH material specification needs. Tests were completed in both the MTF and VTF. Heat 203, a 300 hour continuous operation test, was completed in the MTF. Test 4, including 790 hours and 1341 cycles of operation, was completed in the VTF. Design work was completed for modifications to the MTF to increase the matrix flow area, incorporate a ceramic dome type matrix support, and allow testing of larger numbers of refractory materials. Construction of the modified MTF was begun. Several alternate MHD heater concepts were investigated, including a ceramic intermediate temperature air heater, definition of design conditions and conceptual layouts for a HTAH for a 600 MW/sub e/ MHD plant, and investigation of several aspects of HTAH performance, including radial temperature profile effects and HTAH system startup and part load operation. The size/cost and SCAMP computer codes, as well as several other computer codes used in the HTAH studies, were converted for use and implemented on a corporately owned computer to effect substantial savings in computer costs associated with planned future studies.

792 (DOE-tr—273-Vol.3, pp 3H10.1-3H10.4) **Cold flow study of turbulent mixing in a secondary combustor.** Foote J.P.; Giel, T.V. Jr.; Shulz, R.J. (University of Tennessee Space Institute, Tullahoma, Tennessee). 1983. Translation source information not available . NTIS, PC A15/MF A01. File Number DE85043333. Contract AC02-79ET10815.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth international conference on MHD electrical power generation. Volume 3.

A water flow model of the secondary combustor in the Low Mass Flow Magnetohydrodynamic (MGD) test train at the U.S. Department of Energy Coal Fired Flow Facility was tested in order to determine the effects of combustor geometry and combustion air injection techniques on the flow and mixing in the secondary combustor. A dual Bragg cell laser velocimeter was used to obtain detailed two component velocity data for various model configurations. 4 refs., 3 figs.

793 (DOE-tr—273-Vol.3, pp 3J8.1-3J8.10) **Advanced optical diagnostic techniques for coal fired magnetohydrodynamic electrical power generation.** Murphree, D.L.; Ali, M.F.; Bauman, L.E.; Beiting, E.J.; Benton, R.D.; Cook, R.L.; Daubach, R.O.; Gassaway, J.D.; Luthe, J.S.; Shepard, W.S. (Magnetohydrodynamic Energy Center, Mississippi State University). 1983. Translation source information not available . NTIS, PC A15/MF A01. File Number DE85043333. Contract AC02-80ET15601.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth international conference on MHD electrical power generation. Volume 3.

Advanced optical diagnostic techniques and instrumentation systems are being developed at Mississippi State University for the U.S. Department of Energy's (DOE) magnetohydrodynamics (MGD) program and other fossile energy technologies. Such diagnostic instrumentation can provide the information required to more clearly characterize the various processes involved in the ash seed laden gas stream of a coal fired magnetohydrodynamic flow. This paper describes briefly the present status of some of the various techniques being developed to characterize the magnetohydrodynamic gas stream. 21 refs., 13 figs., 1 tab.

794 (DOE-tr—273-Vol.3, pp 3J12.1-3J12.4) **Analysis of modified line reversal temperature measurement systems applicable to coal fired magnetohydrodynamic systems.** Winkleman, B.C. (The University of Tennessee Space Institute, Tullahoma, Tennessee). 1983. Translation source information not available . NTIS, PC A15/MF A01. File Number DE85043333. Contract AC02-79ET10815.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth international conference on MHD electrical power generation. Volume 3.

The modified line reversal technique for measuring the temperature of hot plasma flow in coal fired magnetohydrodynamic (MGD) power generation systems is evaluated. A formulation relating pertinent optical parameters to measured temperatures was used to define inaccuracies in those temperatures due to misalignment of the optics for the collimated optical system generally employed. The results are presented as functions of the extent of incomplete overlapping of the detector with the images of the reference source plus plasma and the plasma alone. The results are also used to characterize measurement errors introduced by partial slag blockage of optical ports for coal fired magnetohydrodynamic systems. 6 refs., 4 figs.

795 (DOE-tr—273-Vol.3, pp 3J10.1-3J10.4) **Temperature and spectral emission and transmission measurements in a coal fired magnetohydrodynamic system.** Winkleman, B.C.; Baucum, W.E.; Giel, T.V. Jr. (The University of Tennessee Space Institute, Tullahoma, Tennessee). 1983. Translation source information not available . NTIS, PC A15/MF A01. File Number DE85043333. Contract AC02-79ET10815.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth international conference on MHD electrical power generation. Volume 3.

Plasma temperatures in coal fired magnetohydrodynamic (MGD) systems are generally only measurable with optical radiometric techniques such as emission pyrometry (that is, luminosity) and modified line reversal. However, implementation of radiometric techniques is constrained by the plasma emission and transmission characteristics. The emissions of coal fired magnetohydrodynamic plasmas are spectrally characterized. The effect of these characteristics on temperature measurements made with luminosity and modified line reversal techniques is considered as are the effects on temperature measurements due to the unsteady nature of the plasma emissions observed in a coal fired magnetohydrodynamic development facility. 3 refs., 4 figs.

796 (DOE-tr—273-Vol.3, pp 3J11.1-3J11.4) **Development of a photodiode line reversal system for coal fired magnetohydrodynamic plasma characterization.** Winkleman, B.C.; Giel, T.V.; Schulz, R.J. (The University of Tennessee Space Institute, Tullahoma, Tennessee). 1983. Translation source information not available . NTIS, PC A15/MF A01. File Number DE85043333. Contract AC02-79ET10815.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth international conference on MHD electrical power generation. Volume 3.

A new, compact, rugged and inexpensive, photodiode based design for a modified line reversal system is described. The design uses optical filters for spectral wavelength discrimination and optical spatial rather than electromechanical signal separation. Require-

ments for the plasma spectral emission characteristics and the optical configuration are discussed. Concurrent measurements made in a coal fired, open cycle magnetohydrodynamic development facility with the new and standard modified line reversal systems are compared to illustrate the applicability of the new system. 4 refs., 4 figs.

797 **Tectosilicates--new data on processing, physical and electronic properties, and chemical durability.** Cook, L.P.; Chiang, C.K.; Hahn, T. pp 137-142 of Proceedings of the 7th annual conference on materials for coal conversion and utilization. Gaithersburg, MD; National Bureau of Standards (1982). (CONF-821145—).

From 7. materials for coal conversion and utilization conference; Gaithersburg, MD, USA (16 Nov 1982).

The extended abstract outlines the second of a series of papers aimed at defining the potential of the structural family of compounds known as the tectosilicates for MHD ceramic materials applications at moderate to high temperatures.

3004 Thermionic Converters

798 **(DOE/CE/40635—2) Thermionic energy conversion design for chlorine-caustic soda application. Final report.** Miskolczy, G.; Turner, R.A.; DeLuca, R.; Morgan, D.T.; Dick, R. (Thermo Electron Corp., Waltham, MA (USA). R and D New Business Div.; Crawford and Russell, Inc., Stamford, CT (USA); Rasor Associates, Inc., Sunnyvale, CA (USA); Stone and Webster Engineering Corp., Boston, MA (USA)). 1985. Contract AC02-83CE40635. 201p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86000210.

This report presents the results of the study of thermionic cogeneration installed in a chlorine-caustic plant. The study includes a survey of those US chlorine plants which use diaphragm cells. The study shows that it is technically feasible to equip the plant with thermionic cogeneration. Thermionic combustors replace the existing burners and are capable of generating approximately 2.6 MW of dc power. This satisfies about 5% of the power demand of the chlorine cells. A typical plant was defined for detailed consideration. This plant produces 470 US tons of chlorine per day. The thermionic cogeneration combustors are high temperature burners in which thermionic converters are arranged in an array around the flame, near the combustor wall. The combustor flame heats a cellular, ceramic radiator, which transfers heat to the emitters of the thermionic converters. These converters transmit heat to the combustion air which is heated to a high temperature, allowing the burner to produce the high flame temperature required to heat the thermionic converters. The thermionic converters are of the same design as has been extensively tested in similar flame-heated environments. The performance of the converters assumed in the study corresponds to that measured in the laboratory under similar service conditions. The study shows that the cost estimate of thermionic cogeneration installed in the typical chlorine-caustic plant is $1500 per kW. The cost of capital and other finance charges during construction are not included in these estimates. The cost savings by thermionic cogeneration is estimated by subtracting the cost of additional fuel from the cost of the additional electrical power produced. With an electricity cost of 60 mils/kWh and a fuel cost of 13.7 mils/kWh ($4 per million Btu), the cost savings is estimated as $953,000. With the capital cost of $3,936,000, the simple payback is four years.

799 **Calculational models of close-spaced thermionic converters.** McVey, J.B. (RASOR ASSOCIATES, INC., Sunnyvale, California). pp v of 1983 IEEE Interation Conference on Plasma Science. New York, N.Y.; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

Two new calculational models have been developed in conjunction with the SAVTEC experimental program. These models have been used to analyze data from experimental close-spaced converters, providing values for spacing, electrode work functions, and converter efficiency. They have also been used to make performance predictions for such converters over a wide range of conditions. Both models are intended for use in the collisionless (Knudsen) regime. They differ from each other in that the simpler one uses a Langmuir-type formulation which only considers electrons emitted from the emitter. This approach is implemented in the LVD (Langmuir Vacuum Diode) computer program, which has the virtue of being both simple and fast. The more complex model also includes both Saha-Langmuir emission of positive cesium ions from the emitter and collector back emission. Computer implementation is by the KMD1 (Knudsen Mode Diode) program. The KMD1 model derives the particle distribution functions from the Vlasov equation. From these the particle densities are found for various interelectrode motive shapes. Substituting the particle densities into Poisson's equation gives a second order differential equation for potential. This equation can be integrated once analytically. The second integration, which gives the interelectrode motive, is performed numerically by the KMD1 program. This is complicated by the fact that the integrand is often singular at one end point of the integration interval. The program performs a transformation on the integrand to make it finite over the entire interval. Once the motive has been computed, the output voltage, current density, power density, and efficiency are found. The program is presently unable to operate when the ion richness ratio β is between about .8 and 1.0, due to the occurrence of oscillatory motives.

800 **High performance, closed-spaced thermionic converters.** Dicky, R.S.; Britt, E.J.; Fitzpatrick, G.O.; McVey, J.B. (Rasor Associates, Inc., Sunnyvale, California). pp v of 1983 IEEE Interation Conference on Plasma Science. New York, N.Y.; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

Near ideal performance in a Thermionic Energy Converter (TEC) can be obtained using extremely small (<5 microns) interelectrode spacings. Previous efforts to build such converters have encountered engineering problems. A new type of converter, called SAVTEC (for Self-Adjusting, Versatile TEC) has been developed at Rasor Associates, Inc., as a practical way to achieve small spacings. During testing at Rasor Associates these converters have been demonstrated to deliver excellent performance. Early work directed towards achieving small emitter to collector spacings was plagued by electrode shorting. Lateral thermal expansion of the electrodes was believed to have caused the ceramic spacers to gouge the emitter and collector, thereby shorting them. This design sought to limit this effect by using small disc-shaped molybdenum electrodes approximately 1 cm (0.400 in) in diameter. In some designs of the SAVTEC, thermal expansion of the emitter electrical lead is used to achieve emitter to collector spacing. In these designs the electrodes are in contact when cold. In other designs spacing is maintained by ceramic fibers between the electrodes. The converter is mounted inside an enclosure which contains cesium vapor. The vapor is used only to establish electrode work functions. However, surface ion production does occur at high emitter temperatures. The spacing in this converter is small enough that at cesium pressures of about 1 torr it operates in the collisionless (Knudsen) mode. Emitter heating is by thermal radiation from a portion of the cesium/vacuum enclosure. This permits the construction of an array of many small converters, all enclosed in the same cesium envelope, in which the emitters are both electrically isolated and free to individually adjust their electrode spacing. Use of these arrays with series-parallel connections allows a system with high reliability and relatively high voltage output.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 1118

801 **The potential market impact of low temperature fuel cell systems.** Meyer, W.; Wilemon, D.; Bretschneider, S.; Shangraw, R.; Thomas, S.; Olivette, M.; Hick, P. (Syracuse Univ., Inst. for Energy Research). pp 1125-1137 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The following major conclusions have been drawn from this study: The relative price between electricity and gas has a marked effect on the economic market for on-site fuel cell systems. If the energy cost of gas increases at a rate faster than that for electricity, then the economic market will be sharply reduced compared to the case where the present relative price differentials is maintained. The installed first cost of the fuel cell must be reduced to about $1100 (1982$) per kWE to produce a significant gas-powered fuel cell market. The economic market for fuel cells is enhanced by the availability of a buy all sell all option. The economic market will tolerate a lease option with a 40% return on investment to the leasee. On a conservative basis, over the four twenty year time frames studied, fuel cells will enhance gas sales to the commercial and light industrial market from less than 1% in the first time frame to about 10% in the fourth time frame.

802 **Fuel cell field test results.** Reid, E.A.; Cuttica, J.J. (Columbia Gas System Service Corp.). pp 1116-1124 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The gas industry together with the support of GRI and the Federal Government is in the midst of a large field test program which includes the manufacture, delivery, installation, operation, and maintenance of over forty 40kW onsite fuel cell power plants. These onsite power plants, which are referred to in the gas industry as Gas Powercels, provide both the electrical and thermal requirements of many building owners with one single piece of hardware, fueled by natural gas. To date, over 25,000 hours of operation have been accumulated on thirteen power plants, with the general experiences being very positive. Successful completion of this field test project combined with the results of parallel technology development and industry user group projects will result in the commercial availability of the Gas Powercel in the late 1980s.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 774

3201 Buildings

REFER ALSO TO CITATION(S) 354, 390, 401, 802, 832, 1215

803 **(CONF-840816—25) Design of dehumidifiers for use in desiccant cooling and dehumidification systems.** Van den Bulck, E.; Mitchell, J.W.; Klein, S.A. (Wisconsin Univ., Madison (USA). Solar Energy Lab.). 1984. Contract AC03-79SF10548. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018192.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

The use of rotary dehumidifiers in open cycle desiccant cooling systems is investigated by analyzing the performance of the rotary heat exchanger-rotary dehumidifier subsystem. For a given cooling load, the required regeneration heat supply can be minimized by choosing appropriate values for the regeneration air mass flow rate and the wheel rotation speed. A map is presentd showing optimal values for rotational speed and regeneration flow rate as a function of the regeneration air inlet temperature and the process air inlet humidity ratio. This regeneration temperature is further optimized as a function of the process humidity ratio. In the analysis, the control strategy adjusts the process air mass flow rate to provide the required cooling load. Additional control options are considered and the sensitivity of the regeneration heat required to the wheel speed, regeneration air mass flow rate and inlet temperature is discussed. Experimental data reported in literature are compared with analytical results and indicate good agreement. 32 refs., 7 figs., 2 tabs.

804 **(DOE/CE—0037/1) Bibliography of the DOE building equipment research program.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Building Equipment Div.). Sep 1985. 105p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86001591.

This bibliography contains a compilation of reports and technical papers resulting from research activities sponsored by the Energy Conversion Equipment Program. These publications are listed under the following chapter headings: Appliances, Combustion Systems Technology, Lighting Technology, Refrigeration and Heat Pump Technology, and Thermally-Activated Heat Pumps. Because Equipment Integration is a new program element, few reports have been generated at this time. The focus of research efforts for each program element is described in greater detail at the beginning of each respective chapter. Publications have been organized in chronological order beginning with the most recent report. Source information and an abstract accompany each entry. The bibliography concludes with a list of addresses for obtaining copies of the publications and a subject index.

805 **(DOE/CH/10223—T1) Weatherization Assistance Program monitoring, fiscal year 1984. Final report.** Poston, P.R.; Walsh, J.H.; Bradshaw, D.S. Jr.; Ledgerwood, B. (B and M Technological Services, Inc., Cambridge, MA (USA)). Apr 1985. Contract AC02-84CH10223. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001157.

B and M Technological Services, Inc. (B and M), under contract to the US Department of Energy, Chicago Operations Office, State and Local Conservation Programs Division (CH/SLCP), monitored the fiscal year 1984-funded Weatherization Assistance Program in six midwestern states. Program monitoring is required by the Energy Conservation and Production Act (PL 94-385) and the regulations at 10 CFR 440 to ensure effective provision of weatherization assistance to low-income persons. This Final Report presents an overview and summary of the work performed by B and M, including discussion of the findings of the monitoring team regarding the accomplishments and problem areas observed among the subgrantees visited. In summary, subgrantee performance in administrative areas such as organization, outreach, and financial procedures was generally good. Problems were observed in the areas of job assessment, workmanship, and final inspection at several of the subgrantees monitored. Recommendations to improve operations of the subgrantees visited were presented in the reports prepared on the work in their respective states. Some additional recommendations are presented here concerning the problematic nature of the cost-effectiveness of bulk purchasing versus alternative approaches to materials procurement; coordination problems with other weatherization-related services, especially as regards client safety; and on other matters. The contracts and budgets examined appeared to meet all Federal requirements, provide for sound management of Federal funds and to have been properly executed.

806 **(DOE/CS/69129—T1) Home buyer's guide to energy efficient living.** (Utah Energy Office, Salt Lake City (USA)). 1985. Contract FG48-80CS69129. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001822.

If you are buying - or considering buying - a new or existing home, this guide is for you. It will help you choose a home that is efficient to heat and cool, which will save you money. There are many factors to consider when examining a home. The cost of heating and cooling may not be the most "glamorous" factor, but it should be an important consideration. Energy costs have risen considerably in recent years and are predicted to be even higher in the future. The choice you make could mean a difference of thousands of dollars in long term energy costs. Do not ignore energy costs in making this important purchase decision. Using this guide will help you make an informed decision. Do not take energy efficiency in new homes for granted. Look at energy efficiency features before making a choice. Obtain energy cost estimates and carefully evaluate them. When looking at a home, use the energy Checklist in this guide. Remember, by choosing an energy-efficient home you may save hundreds of dollars each year - and have improved comfort and livability as well.

807 **(DOE/R1/26235—T1) Free-air: ambient air refrigeration system. Final report.** (Vermont Iron Stove Works, Inc., Waterbury (USA)). 10 Nov 1983. Contract FG41-81R126235. 23p. (VT—81-003). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000364.

The purpose of the project was to partially fund the construction, installation and monitoring of prototype devices that work on the principle of ambient air refrigeration. We call these devices FREE-AIR devices because because they utilize a source of refrigeration that exists in abundance all around us here in Vermont (and elsewhere) for much of the year: cold outside air. This air is free and the electrical energy required to capture it, while not free, is at least not expensive when compared to conventional compressor-driven refrigeration equipment. Whether working alone or in conjunction with a compressor system, a FREE-AIR device thermostaticly senses both the temperature of the outdoors and of the space to be cooled and brings in coal outside air, when necessary, to maintain a constant temperature. One of the unexpected positive results of prototype number 7 and number 8 is that the basic design is suitable not only for residential root and wine cellars, but also for commercial applications in which it would work in conjunction eith conventional refrigeration equipment without the need for a direct electrical connection to that equipment. This means that a single self-contained unit could serve the needs of a wide market and be installed easily by anyone familiar with common carpentry tools without the need for an electrician. These are critical considerations for Vermont Iron when deciding if the FREE-AIR makes sense as an addition to our product line. While that decision has not been made at this time there is a strong possibility that a production model of the FREE-AIR will be available this coming winter.

808 **(DOE/R2/05040—T1) IATS final report.** Alexander, R. (Alexander (Richard), Mayville, NY (USA)). [1985]. Contract FG42-79R205040. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000502.

In September 1979, Chautauqua Opportunities received a grant from the Department of Energy Appropriate Technology Small Grant Program. The I.A.T.S. project began in response to local need and interest in developing a small-scale a.t. research and development center. A project review committee was formed consisting of members representing a broad scope of talents and interests including engineers, an architect, building contractors, and concerned citizens. The project review committee selected five farm units to receive the integrated systems. Various combinations included bioconversion, passive solar, and heat reclaiming techniques. In addition, the review committee awarded six self help projects. The participants of the project formed the central core of a self help support group. Applications and project status are included separately. Once approval for an agency location was granted by the review committee, a more detailed on-site inspection was conducted to determine the primary system installation and the combinative support systems. Of the five locations, three received an attached solar heat cell, and two received a methane digestor as a primary system. The combinative support systems included the installation of a direct gain seasonal, solar water heater, heat reclaiming water heater, and thermal shutters. The two locations that received the methane digestors also received attached solar heat cells as secondary systems. Two different designs were used for the methane digestors. Both operate as continuous feed, mesophillic, non-agitative, anaerobic digestors. One was installed on an operating hog farm, and one was installed on an operating dairy farm.

809 **(EUR—9788-EN) Periodically operating absorption heat pump.** Grabenhenrich, H.B. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 56p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Based on the simple idea of a periodically operating absorption heat pump, a directly fired type has been designed and built for space heating applications. The heat input is accomplished by means of a natural gas burner sized at approximately 10 kW and the low temperature heat source is furnished by the ambient air. Prior to the design, extensive investigations have been performed to determine the heat and mass transfer rates in the necessary components. In a laboratory size unit the transport phenomena for the ternary mixture methanol-water-lithiumbromide have been measured first. Investigations already have been made for the working pair water-lithiumbromide within an increased temperature range. This data will be necessary for the possible second stage of the device. The results of the preliminary experiments, especially the achieved mean heat output and the heat transfer coefficients, proved that a technically scaled unit can be designed and constructed with an acceptable overall size. A testing setup, well matched to the instationary conditions of this heat pump system is constructed in order to perform the investigations of operation modes and the determination of specific process data. These results can be obtained by qualified programs. The prototype already has been integrated and put into operation, successfully. Some test runs in generator/absorber mode of operation followed, subsequently, C.O.P.'s of more than 1.2 are achieved (difference of temperature evaporator-absorber proportional 40 K) though it turned out that some details of construction still have to improve. At present the load characteristics are determined for variing operating conditions.

810 **(EUR—9845-EN) Development of a grid-independent automatic multiple film blind system for temperature control in buildings.** Deuble, W.; Schmid, J. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 28p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The aim of this project was to develop a highly efficient temporally variable heat and sunlight protective device for windows, allowing optimal passive use of solar energy. The operating principle is based on influencing the energy flow through the window in both directions by using different selectively coated films. During the day in summer, the system is transparent only to light; the near IR fraction of the solar spectrum is reflected. By contrast, during winter days the window should be transparent for the whole solar spectrum and should only reflect the far IR radiation from the room. During winter nights, all the visible part of the spectrum as well as the near and far IR components of the radiation should be reflected. The k-value of a double glazed window was measured and found to improve from 2.7 W/m^2K to 1.1 W/m^2K when fitted out with the heat insulating film. This improvement was obtained by reducing the radiation exchange between the glass panes to less than 10% as well as dividing the volume between the panes into two separate compartments.

811 **(LBL—19348) Monitored energy performance of new and retrofitted residential buildings: results from the "BECA" data base.** Harris, J.P. (Lawrence Berkeley Lab., CA (USA)). Jun 1985. Contract AC03-76SF00098. 18p. (CONF-850402—1; EEB-BED—85-03). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000626.

From 2. international conference on consumer behaviour and energy policy; Paris, France (10 Apr 1985).

We summarize measured energy performance data, drawn from the "BECCA" data base at LBL, on several hundred new and retrofitted residences. We explore the two-way relationship between occupant behavior and the physical characteristics and energy performance of residential buildings. A more detailed, empirical understanding of both physical and occupancy variables is needed to help explain the observed variance in energy performance among physically similar houses, as well as the variance between performance predictions and actual measurements. Physical and occupancy factors may be difficult to separate, in theory as well as in practice. The evaluation of "occupant effects" raises questions not only of sufficient data, but of inadequate definition of the outputs resulting from energy use: occupant comfort, well-being, and other "building services." Thus, energy efficiency is properly defined not as reduced consumption, but as a change in the ratio of energy used to services obtained. A concluding section discusses some implications, both for research and for energy conservation policy and programs, of a broadened perspective that embraces both physical and occupant effects on building energy performance. 11 refs., 5 figs.

812 **(NP—86770025) Solar cadastre in south Hessen. Study of experiences with solar heating systems.** (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Jan 1985. 188p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE86770025.

Using a collection of data on solar heating systems in South Hessen, this project set out to offer the consumer a survey of experiences and problems with solar heating systems; also to show what possibilities are open to people for using solar energy actively and to what extent solar energy can cover heat consumption. Figures from 70 plants have been gathered. However, the number of plants at which measurements were taken for the energy bilance, was restricted to a maximum of ten. The following points were included in the programme: Questionaires for gathering information about the solar heating systems used in South Hessen, measurements for the determination of efficiency and of the characteristic quantities of plants, economic studies of the profitability of solar heating systems and conclusions and recommendations.

813 **(ORNL/Sub—79-42539/4) Calibrated hot box test results data manual. Volume 1. Final report.** Van Geem, M.G. (Construction Technology Labs., Skokie, IL (USA)). Nov 1984. Contract AC05-84OR21400. 342p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE86001473.

This manual summarizes results from 15 wall assemblies tested under steady-state and dynamic temperature conditions in the calibrated hot box facility. The calibrated hot box provides data on the heat transmission characteristics of full-size wall assemblies under steady-state and dynamic temperature conditions. Steady-state tests are used to obtain average heat transmission coefficients. Dynamic tests provide data on thermal performance under controlled conditions that simulate actual temperature changes in building envelopes. This manual summarizes test results of six concrete masonry walls, two masonry cavity walls, three concrete walls, three wood frame walls, and a brick veneer-wood frame wall. A description of wall geometry and material properties is given for each specimen. The manual presents steady-state, transient, and dynamic (periodic) test results in tabular form, in figures, and in summary tables.

814 **(PB—85-223394/XAB) Market evaluation for advanced integrated appliances. Rept. for December 1982-March 1984.** Novil, M. (Institute of Gas Technology, Chicago, IL (USA)). Apr 1985. 63p. NTIS, PC A04/MF A01.

Attitudes of homebuilders, appliance manufacturers, and appliance distributors, as well as existing consumer data were surveyed to assess the market constraints to introducing potentially space-efficient and energy-saving integrated residential gas appliances. The decision criteria important to each group was combined to indicate the issues that must be overcome to make these conceptual gas appliances a commercial success when developed.

815 **(PB—85-223915/XAB) Microcomputer-aided design of air-conditioning systems: reference manual for program BSIMAC.** Bartlett, T.P. (National Mechanical Engineering Research Inst., Pretoria (South Africa). Heat Mechanics Div.). Feb 1984. 48p. NTIS, PC A04/MF A01.

The reference manual describes the micro-computer version of the air-conditioning design program SIMAC. The version of the program is named BSIMAC; the prefix B refers to BASIC, the computer language in which the program is written. The version of BASIC used is Microsoft's MBASIC which runs under the CP/M (Control Program/Monitor) operating system. BSIMAC, which has been developed specifically for South African conditions, is intended as a basic tool for the design and analysis of air-conditioning systems. It computes the cooling and heating loads and room temperatures in air-conditioned buildings. The computations can be done for various plant-operating modes and different types of control equipment.

816 **(PNL—5496-Rev.1) Marketing energy conservation options to Northwest manufactured home buyers. Revision 1.** Hendrickson, P.L.; Mohler, B.L.; Taylor, Z.T.; Lee, A.D.; Onisko, S.A. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 185p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86001437.

Manufactured, or HUD-Code, homes comprise a growing share of the housing stock in the Northwest, as well as nationally. Their relatively low cost has made them especially attractive to lower income families, first-time home-buyers, and retired persons. The characteristics of manufactured home (MH) buyers, the unique energy consumption characteristics of the homes, and their increasing market share make this market an especially critical one for energy consumption and conservation planning in the Northwest. This study relies on extensive, existing survey data and new analyses to develop information that can potentially assist the design of a marketing plan to achieve energy conservation in new manufactured homes. This study has the objective of assisting BPA in the development of a regional approach in which numerous organizations and parties would participate to achieve conservation in new manufactured homes. A previous survey and information collected for this study from regional dealers and manufacturers provide an indication of the energy conservation options being sold to manufactured home buyers in the PNW. Manufacturers in the Northwest appear to sell homes that usually exceed the HUD thermal requirements. Manufacturers typically offer efficiency improvements in packages that include fixed improvements in insulation levels, glazing, and infiltration control. Wholesale costs of these packages range from about $100 to $1500. Typical packages include significant upgrades in floor insulation values with modest upgrades in ceilings and walls. This study identifies trends and impacts that a marketing plan should consider to adequately address the financial concerns of manufactured home buyers.

817 **(PNL—5607) Research utilization in the building industry: decision model and preliminary assessment.** Watts, R.L.; Johnson, D.R.; Smith, S.A.; Westergard, E.J. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86001682.

The Research Utilization Program was conceived as a far-reaching means for managing the interactions of the private sector and the federal research sector as they deal with energy conservation in buildings. The program emphasizes a private-public partnership in planning a research agenda and in applying the results of ongoing and completed research. The results of this task support the hypothesis that the transfer of R & D results to the buildings industry can be accomplished more efficiently and quickly by a systematic approach to technology transfer. This systematic approach involves targeting decision makers, assessing research and information needs, properly formating information, and then transmitting the information through trusted channels. The purpose of this report is to introduce elements of a market-oriented knowledge base, which would be useful to the Building Systems Division, the Office of Buildings and Community Systems and their associated laboratories in managing a private-public research partnership on a rational systematic basis. This report presents conceptual models and data bases that can be used in formulating a technology transfer strategy and in planning technology transfer programs.

818 **(PNL-SA—13040) Testing energy concepts for an office building.** Crawley, D.B.; Kimsey, S.P. (Pacific Northwest Labs., Richland, WA (USA); Heery Energy Consultants, Inc., Atlanta, GA (USA)). Jul 1985. Contract AC06-76RL01830. 9p. (CONF-8503101—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001645.

From Research and design '85; Los Angeles, CA, USA (14 Mar 1985).

Energy Design Guidelines for Offices and Schools are currently being developed by the Tennessee Valley Authority (TVA) for designers in the Tennessee Valley region. TVA also plans to develop similar guidelines for other building types. Development of the Energy Design Guidelines for Offices included an analysis of a generic office building to demonstrate the integration of energy efficiency into the standard design process for office buildings. Glaz-

ing, lighting system, and air delivery system alternatives were first tested to determine the best combination for energy efficiency and economic performance, then an additional set of HVAC system options were tested. Based on these energy/economic evaluations, an optimum set of energy concepts was selected for incorporation into the building design. The DOE-2.1A energy analysis program was used to analyze energy performance of the combinations and the cost-effectiveness of the various options was analyzed with an economic evaluation program. Financial criteria of a developer/owner were incorporated to demonstrate typical project economic goals or expectations.

819 **(TVA/PE/CEM—85/71) Encouraging the construction of energy-efficient homes. A utility perspective.** Kimmons, G.H. Jr.; Burch, P.W. (Tennessee Valley Authority, Chattanooga (USA). Div. of Conservation and Energy Management). 1985. 4p. NTIS, PC A02/MF A01. File Number DE86900099.

Historically an industry with a supply side orientation, electric utilities are becoming increasingly involved with the end usage, or demand side, of their product as a means of effectively managing their systems. The Tennessee Valley Authority (TVA) has been actively involved in a variety of demand side energy conservation and management programs since 1977. One such program, designed to encourage the construction of energy-efficient new housing in the Tennessee Valley, now offers, through local electric power distributors, cash incentive payments to the builders and buyers of energy-efficient new homes. This paper discusses key features of the program and the rationale of a utility's involvement in encouraging energy-efficient construction.

820 **(TVA/PE/PPN—85/1) Residential appliance electricity demands in the TVA power service area. A conditional demand analysis based on TVA's residential surveys conducted in 1979, 1981, 1982 and 1984.** Jackson, G.L. (Tennessee Valley Authority, Chattanooga (USA). System Forecasting Group). Jul 1985. 44p. NTIS, PC A03/MF A01. File Number DE86900100.

This report describes estimates of residential appliance-specific electricity consumption for the Tennessee Valley Authority's power service area. These are reported for actual and normal weather conditions and for both all living quarters and single family. The conditional demand analysis (CDA) model used to provide these estimates is also described in this paper. This model not only provides appliance-specific electricity consumption estimates but explains changes in these estimates as a function of economic, demographic and weather variables.

821 **(OA-Trans—2736) Energy balance of the living area of a dwelling.** Truemper, H.; Hain, K. Translated from *Elektrowaerme International, Edition A: Elektrowaerme im Technischen Ausbau ;* **43**: No. A1, A24-A27(Jan 1985). 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85902069.

The authors present four variants of ventilating systems for dwellings. They comprise simple transverse ventilation in accordance with the Provincial Building Regulations, an old design of stack ventilation in accordance with DIN 18017, a ventilation system with heat recovery in accordance with VDI 2088, and a system using heat recovery and heat pump. The energy balances of the 4 systems are illustrated by means of energy-flow diagrams.

822 **Estimating energy savings due to conservation program: the BPA residential weatherization pilot program.** Hirst, E.; Goeltz, R. (Oak Ridge National Laboratory, Oak Ridge, TN). *Energy Economics;* **7**: No. 1, 20-28(Jan 1985).

The Bonneville Power Administration operated a residential weatherization pilot program from 1980 to 1982. The program provided free home energy audits to more than 7000 electrically heated homes in the Pacific Northwest and gave zero-interest loans to weatherize over 4000 of these homes. The total cost of the program was $11 million. this paper describes several methods used to estimate the net energy-saving effect of the BPA program (ie the electricity saving that could be directly attributed to the program). The simplest method involves estimation of 'weather adjusted' annual electricity consumption for each household. The second approach uses this weather adjusted consumption as the dependent variable in a pooled time-series cross-section regression model of electricity use. The third approach involves estimation of qualitative choice models of the decisions to retrofit and to participate in the BPA program. Results from these models are used to define Mills ratio terms that are then used as explanatory variables in the regression model of the second approach. The range in estimated program saving, given the diversity of analytical methods used, is surprisingly small - 3100-3300 kWh/year per average program participant.

823 **Development of a gas engine heat pump for domestic and commercial use.** Kawamoto, H.; Takata, Y.; Shibuya, K. (Gas Utilization Technology Center Osaka Gas Co., Ltd.). pp 930-939 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The gas engine heat pump system, consisting of gas engine, refrigerant compressor, various heat exchangers and hot water storage tank, has three functions: cooling, heating and hot water supply. For domestic use, these are combined in one unit. The efficiency of the gas engine itself is 25 28% in terms of gross calorific value. C.O.P. of the whole system is 0.8 for cooling, 1.2 for heating, and approx. 1.4 for hot water supply. Hot water temperature during hot water supply operation reaches approx. 60\C; the highest water storage temperature permitted is 90\C. This heat pump system is presently undergoing field test, from which various data is being collected. The heat pump system, having already proven its function and efficiency, will be improved for lighter weight and increased durability.

824 **An economic assessment of the residential add-on electric heat pump in the United States.** Kazmer, K.; DeLima, H. (Gas Research Inst.). pp 1003-1012 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Although the add-on electric heat pump can be installed on either an oil, gas or electric warm-air furnace, this paper only presents results related to its installation on a gas furnace. If the homeowner's existing air conditioner fails, he would be better off replacing the failed unit with another air conditioner rather than installing an add-on electric heat pump to his existing gas furnace. The major findings that support this conclusion are: Initial installed costs for add-on electric heat pumps are several hundred dollars greater than for air conditioners; Conventional gas furnaces have lower heating bills than add-on electric heat pumps. In instances where heating saving do result, the payback period is greater than the expected life of the add-on electric heat pump; Total first-year operating costs are lower for conventional gas furnace and air-conditioning systems than for add-on electric heat pumps.

825 **A tool for evaluating residential and commercial heating and cooling equipment.** DeLima, H.; Kazmer, K.C. (Applied Management Sciences Inc.). pp 986-995 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A tool was developed for use by the Gas Research Institute of the United States to evaluate the seasonal technical performance and economic performance of space heating and cooling equipment such as heat pumps, air conditioners, and furnaces. This tool enables a Research and Development (R & D) Manager to evaluate the competitiveness of a specific technology on the basis of heating and cooling efficiencies and cost considerations. The tool is based on the American Society of Heating, Refrigerating, and Air Conditioning Engineers' (ASHRAE) Bin Method and can be used for estimating performance of equipment at virtually any location for which Bin weather data are available. The procedure is applicable to single-speed, multispeed, and fully modulating compressors, add-on heat pumps, gas-fired heat pumps, furnaces, and all conventional residential heating and cooling equipment. The tool is developed in

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three versions: a step-by-step procedure using worksheets, a computer spreadsheet version, and a fully interactive microprocessor-based model written in Pascal.

826 **Energy efficiency in Chinese apartment buildings: parametric analysis with the DOE-2.1A computer program.** Huang, Y.J.; de Piedade, A.C.; Rosenfeld, A.M.; Tseny, D. (Applied Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Energy (Oxford);* 9: No. 11/12, 979-994(Nov 1984).

Using an uninsulated Beijing apartment house of standard design as a base case, the DOE-2.1A energy analysis program is used to study the cost-effectiveness of moreenergy-efficient designs. Two measures have attractive simple payback times; reduced infiltration(1-2 yr payback) and insulation of the north wall (6 yr). The cost of conserved coal for the insulation measure is less than half the international price of coal. This insulation adds only 0.6% to the first cost o the building, yet, combined with more attention to infiltration, it reduces annual heat load from 230 to 130 MJ/m². Furthermore, the first cost of these two measures may be offset by savings from downsizing the heating plant. In Shanghai, reduced infiltration and insulation are justified not o the basis of saving fuel, but because they make dwellings more comfortable.

827 **TNODE-A microcomputer-based thermal network simulation program.** Benton, C.C.; Akridge, J.M. (Coll. of Architecture, Georgia Inst. of Technology, Atlanta, GA 30332). pp 43-48 of Proceedings of the Ninth National Passive Solar Conference. Hayes, J.; Wilson, A. Boulder, CO; American Solar Energy Society (1984). (CONF-840954—).

From 9. national passive solar conference; Columbus, OH, USA (23 Sep 1984).

A microcomputer-based thermal network simulation program is described. TNODE, a 20 node thermal simulation program, is presented in the context of a sample problem. The program's organization and input data requirements are described. Samples of simulation runs are presented with a comparison between the example run and empirical data collected from a simple concrete slab. Instructions are provided for receiving a low cost copy of TNODE from the Designers Software Exchange.

828 **THERMAL-LITE: A microcomputer program for thermal and daylighting analysis.** Bryan, H.; Hoshino, M. (Dept. of Architecture, Massachusetts Inst. of Technology, Cambridge, MA 02139). pp 31-36 of Proceedings of the Ninth National Passive Solar Conference. Hayes, J.; Wilson, A. Boulder, CO; American Solar Energy Society (1984). (CONF-840954—).

From 9. national passive solar conference; Columbus, OH, USA (23 Sep 1984).

This paper describes a microcomputer program called THERMAL-LITE, which has been designed to predict the amount of energy savings attributed to the use of daylighting. THERMAL-LITE consists of four major subprograms -- data input, thermal calculation, daylighting calculation and output. The data input program is organized around a set of fourteen options, where design parameters can easily be created, stored, replaced or changed to determine the effect of design alternatives early in the design process. The thermal calculation that is used was taken from the public domain program called ASEAM, which is capable of predicting both peak and annual energy use for a building by utilizing the ASHRAE TC 4.7 Modified Bin algorithm. The daylighting calculation that is used was derived from an algorithm that was first developed by Higbie. The output is capable of two types of reports -- peak values and annual energy consumption. Future developments that will further increase the program's effectiveness to the design community are also discussed.

829 **Thermal network reduction.** Balcomb, J.D. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 665-670(Jun 1983).

A method is presented for reducing the number of elements required in a thermal network representation of a building. The method is based on matching the actual building response at two frequencies, the diurnal response and 3-day response. The procedure provides a straightforward methodology for combining all the various materials inside a discrete building zone into a few nodes while retaining a high degree of accuracy in the dynamic response. An example is given showing a comparison between a large network and the reduced network.

830 **Building design using the energy nomographs.** Sain, A.M.; Davy, J.E. (Burt Hill Kosar Rittelmann Associates, Butler, Pennsylvania). *Proceedings of the Annual Meeting - American Section of the International Solar Energy Society;* 6: 683-686(Jun 1983).

Today's building industry is promoting the use of renewable sources of energy to heat, cool, and illuminate commercial buildings. Societies such as the International Solar Energy Society sponsor conferences such as this one to share knowledge and experience in the area of solar energy. However, the technologies presented here assume a need for heating, cooling or illumination. A simple technique is presented for determining the actual heating, cooling, and lighting requirements for commercial buildings, and for reducing those requirements through proper building design before applying solar technologies. The energy nomographs are a graphic energy design tool developed to aid designers in making cost effective decisions about energy alternatives early in the design process. Reducing loads at this point can help reduce the expense of a passive or active solar system which is usually sized to meet a certain percentage of the annual loads.

831 **(BG-Trans—5798) Thermal behaviour of a building and its heating system in variable conditions.** Casier, M.Y. (British Gas Corp., London; Gaz de France, 75 - Paris). 1981. Translation source information not available . 41p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86900160.

The research for energy conservation in the field of space heating leads, at first, to an increase of the thermal insulation level of buildings. This strengthening of insulation is not, however, the only way to achieve significant conservation: a heating system with a regulation mode more fitted to the needs, a better use of the free heat plan contribute to the decrease of consumption and improvement of comfort. In order to determine the best solutions to be selected, the D.E.T.N. of Gaz de France has created the Serval computer program (building simulation in variable conditions) which allows a simulation of the thermal behavior of a building and its heating system in variable conditions. This paper describes the program and gives a few applications examples. The "Serval" computer program should make it possible to examine the thermal behavior of any buildings in variable conditions for the purpose of finding out how to achieve a maximum level of comfort for the lowest possible consumption. The research currently in progress relates to standard arrangements of certain heating systems. The "Serval" program will subsequently be in a position, following the addition of new sub-routines, to be extended to other heating systems, such as for example: installations equipped with energy-saving devices (recuperator, heat pump, etc.); and processes using solar energy, with gas as an auxiliary, to meet some of the premises' heating requirements. It will also be used for the purpose of investigating buildings other than residential ones (tertiary applications).

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832 **(DOE/MI/01010—T1) Transportation and housing energy policies: the energy crisis, minorities, low income and elderly persons in rural and urban perspectives in the southeastern United States.** Holmes, R.A.; Boone, W.; Grandison, C.; Wilson, Z. (Atlanta Univ., GA (USA). Dept. of Political Science). Sep 1981. Contract FG01-80MI01010. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85014748.

The low income, minorities, elderly and handicapped have derived great benefits from the creation of rural transportation systems and the maintenance of relatively low fares in urban mass transit systems made possible by the Section 147 and Section 5 programs. It is essential that the Section 18 program, which also provides operating subsidy monies to keep the fares affordable, be expanded and its funding increased substantially. The Section 5 pro-

gram has been of major benefit to the transportation disadvantaged in urban centers. The proposed cutbacks and elimination of the programs in FY 1985 will create severe hardships for residents of the inner cities. Rather, the federal government should continue to assume the major financial responsibility for subsidizing mass transit and keeping fares low. Although there are some problems with the administration of several of the housing energy programs, they have been helpful to those persons who have suffered most from rising heating fuel costs. The FMHA programs have made possible the purchase or repair of homes by low income, minority and elderly persons. The participants have reduced their heating costs as well as improved their quality of life. Although their funding is insufficient, the weatherization and energy assistance programs have both aided low income, minority and elderly persons and should be expanded in scope through increased funding. Finally, the woodstove project offers some hope for reducing reliance on high cost gas and coal as heating fuels and increasing the utilization of wood. The project has been an unqualified success.

833 **(NP—6900131) Analysis of carpooling in Missouri and an evaluation of Missouri's carpool services.** Barnett, D.R. (Missouri Dept. of Natural Resources, Jefferson City (USA). Div. of Energy). 10 Oct 1984. 96p. Missouri Dept. of Natural Resources, Box 176, Jefferson City, MO 65102. File Number TI86900131.

The evaluation of Missouri's carpool services was conducted as a post hoc evaluation and relied on both primary and secondary data. The period from 1978 through 1983 was analyzed in order to evaluate carpool activities of the Missouri Division of Energy as they related to geographic trends associated with carpooling during that time period. Data on carpooling in metropolitan Missouri indicated that while carpooling was increasing in Kansas city and St. Louis, it was not increasing at a rate equal to the growth rate of the Civilian Labor Forces of the two areas. This factor tended to portray a declining carpool community as measured through vehicle occupancy counts. While the retail of gasoline rose and then started slow decline during the 1978-1983 years, data appeared not to have much correlation between carpool numbers and gasoline prices. Finally, although carpooling program services had been initiated in 1980 in both Kansas City and St. Louis, only 2.63% of all carpooling in Kansas City in 1981, and 1.06% in St. Louis in 1983, could be attributed to the Division of Energy's carpool programs. Not enough primary data was ever collected in these years in the Mid-Missouri Carpool Area. Although carpooling data was found to be abundant, it was also viewed as somewhat sporadic - not constant or regular.

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REFER ALSO TO CITATION(S) 286, 393, 808, 856

834 **(BIA—2/83) Heat recovery from exhaust air as an alternative to redirection of fresh air.** Pfeiffer, W.; Lautner, R.; Willert, G. (Berufsgenossenschaftliches Inst. fuer Arbeitssicherheit, Sankt Augustin (Germany, F.R.)). 1983. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86750280.

For reasons of energy saving, systems are being used on a wider and wider scale to redirect purified waste air back into the room. In order to keep the residual pollutants in the recycled air down to limits that can be justified on health grounds, the purification process for the extracted air must be carried out with due care and effectiveness (heat recovery systems with separate air flows or storage masses with alternate flow). Closer study was made as to whether the transfer performance of a tested small-scale pilot heat recovery plant could be expected from a larger-scale plant. After some introductory explanations of the technical principles of ventilation (redirection of clean air, heat recovery), structural and functional details of recuperators (panels, pipes), integrated systems (circulation, heat pipe), regenerators (capillaries, rotors) are described. Moreover, consideration of economic viability of these heat recovery systems are put forward and the technical measuring tests explained. Measurement results are presented (gaseous and vaporous concentrations) and the application of the results is discussed.

835 **(DOE/CE/40544—T1) Pilot plant development of a chemical air separation process. Interim report, October 1, 1982-September 30, 1984.** Archer, R.A.; Dunbobbin, B.R. (Air Products and Chemicals, Inc., Allentown, PA (USA)). May 1985. Contract AC07-82CE40544. 383p. NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE86000009.

The results of Task 1, Evaluation and Pilot Plant Plan, for the chemical separation of oxygen from air are reported. The separation is accomplished by reacting the oxygen in air with a molten mixture of alkali metal nitrates and nitrites in an absorber. The salt then is circulated in a close loop to a desorber where pure oxygen is released. The work conducted has included process economics; market evaluation; laboratory studies in molten salt chemistry and corrosion resistance of construction materials; operation in a continuous bench scale unit; and pilot plant program definition (Task 2). The work has shown that this oxygen producing process has the potential to compete with cryogenics since this method has a 40% lower energy requirement and a 5% cost advantage in new applications and a 30% advantage in retrofit applications.

836 **(DOE/CS/40419—8) Energy conservation potential of portland cement particle size distribution control. Phase II. Final report, February 1, 1982-July 31, 1984.** Helmuth, R.A.; Whiting, D.A.; Gartner, E.M. (Construction Technology Labs., Skokie, IL (USA)). 1984. Contract FC07-82CS40419. 174p. NTIS, PC A08/MF A01; GPO Dep. File Number DE86001926.

The work described in this report has clearly demonstrated that portland cements made with specific narrow particle size distributions, referred to herein as "CPSD cement." perform as well as or better than "normally fround" portland cements in concrete. Methods of optimizing the composition of CPSD cements were developed and refined. CPSD cements with a maximum particle size (upper fifth percentile diameter) or about 30 micrometers were found to be most suitable for general concrete applications. Production of such cements results in a savings of 28% of finish grinding energy, or 13 kWh/ton (0.13 MMBtu/ton fossil fuel equivalent). It was calcualted that complete conversion of the US cement industry to the production of such CPSD cements, on the basis of projected 1984 production levels, would result in the following total annual national energy savings: 1.3 x 10^9 kWh/y of electrical energy (14 x 10^1a@ Btu fossil fuel equivalent; 11 x 10^{12} Btu/y of fossil fuels. 28 refs.

837 **(DOE/CS/40419—10) High tensile cement pastes as a low energy substitute for metals, plastics, ceramics, and wood. Phase I. Preliminary technological evaluation. Final report.** Weiss, S.J.; Gartner, E.M.; Tresouthick, S.W. (Construction Technology Labs., Skokie, IL (USA)). Nov 1984. Contract FC07-82CS40419. 90p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001925.

This report contains an assessment of new technologies which have effectively increased the tensile strengths of hydraulic cement pastes, resulting in new products which we have termed high-tensile cement pastes (HTCP). Section I summarizes the state-of-the-art in research and development of such products. Section II covers a detailed assessment of possible production techniques and develops product energy requirements and production costs. Finally, in Section III, an assessment is given of the potential national energy savings expected to accrue from full implementation of HTCP technology in the United States. The objective was to estimate the commercial and industrial potential of HTCP products as an energy savings replacement for construction materials now in use, such as metals, plastics, ceramics and wood, with the long term goal of energy conservation in the construction industry. 15 refs., 4 figs., 18 tabs.

838 **(DOE/R0/01238—T1) Alternative technology small grants program. Final report.** (Tilth Association, Seattle, WA (USA)). 1983. Contract FG06-81R001238. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000492.

The Good Shepherd Agriculture Center project began in the late summer of 1980 with six demonstration winter garden plots which were painstakingly carved out of the compacted and hard-

pan soil of the site. After the exhilaration and hope of beginning, Seattle Tilth settled into the hard daily work of trying to keep a small non-profit organization alive, with volunteer staff and very limited resources. Nevertheless, due to the dedication of a core group of volunteers, by the spring of 1981, our demonstration garden was established, we had a monthly newsletter, a workshop schedule and a sense of future direction.

839 **(DOE/R1/10007—T1) Wood-heated Winter Vegetable Greenhouse Demonstration Project. Final project report.** Prussack, H. (High Meadows Farm, Westminster West, VT (USA)). [1985]. Contract FG41-79R110007. 19p. (VT—79-006). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000392.

In order to measure the comparative effectiveness of the project greenhouse and its heating system, a smaller greenhouse (24' x 48') was installed during spring 1981 to act as a control. This smaller greenhouse used the same double layered plastic covering and endwalls. The heating system used - a modern wood stove (Ashley) - relies on heating the surrounding air. Hot air is the typical heating system used in New England greenhouses. However, most are using oil to heat the air. The same varieties of seedling plants were placed in the "control greenhouse" so that their growth response could be compared to those in the project greenhouse. The closed heating system utilizing underground piping circulates water at 95° F, thus maintaining a 75° F ground temperature and a 55 to 65° F air temperature. The air temperature fluctuates depending upon outside weather conditions, sun, hours of daylight, wind velocity, etc. The ground picks up additinal heat from the sun which is stored in the sand, thus, allowing the furnace to be used less. Initially, it took three days to bring the ground temperature up to 75° F and thereafter, it remained constant with one firing of the wood furnace in the morning and another at dusk. Because the ground mass is not exposed to air movement and is well-insulated, it holds the heat, releasing it mostly through conduction. This does, however, present a problem in the growing of some plants such as hanging baskets that do not touch the ground. These must tolerate cooler night temperatures. On the other hand, the constant floor heat provided a dramatic boost in plant growth compared to plant response in the "control greenhouse". Also, stem growth was thicker and plants generally healthier, resulting in a 20% earlier maturation compared to that in the "control greenhouse".

840 **(DOE/R1/10342—T1) Development of a more efficient maple syrup evaporator. Final report.** Parsons, D. (Parsons (Daniel), Richford, VT (USA)). 30 Nov 1982. Contract FG41-80R110342. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000389.

The goal of this project was to retrofit a traditional wood-fired maple syrup evaporator to make more efficient use of the wood fuel. A sap preheater was constructed that used waste heat from the steam to preheat the incoming sap. The preheater was tested on the evaporator and 8% more water was processed. There were some problems that will be discussed in the body of the report. A sap pan with fins incorporated into the bottom (described in the 1st and 2nd quarterly reports) was built but was not tested because the fins could not be properly sealed at the ends. Put more simply, it leaked. The bulk of time and energy was spent designing, building, and installing the forced draft and heat exchanger system (refer to 3rd quarterly report). A squirrel cage blower forced fresh air through twelve pipes that were arranged in the stack to the firebox and a draft inducer was mounted on top of the stack. With this arrangement plus the preheater 27% more water was processed than the original rig with the same amount of wood.

841 **(DOE/R1/10402—T1) [Economics of using sawdust to provide process steam for sawmill operation.] Final report.** (Fort Pelham Wood Products, Rowe, MA (USA)). [1985]. Contract FG41-80R110402. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000359.

The activities involved the conversion of the power source of an operating small sawmill from a combination of fossil fuels and electricity to steam derived from the burning of sawmill wastes. Installation of low-level technologies, including a boiler and large amounts of basic plumbing, and the construction of a weather-proof enclosure to house the process, demonstrated that sawmill wastes could produce enough power to operate a sawmill at full capacity, without the use of other energy sources, with a short payback period.

842 **(DOE/SF/11608—T1) Diffusion and adoption of an efficient, integrated alternative energy system: a producer gas-solar greenhouse for farmstead operation. Final technical report, September 1, 1980-October 1983.** Peterson, G.T. (College of the Siskiyous, Weed, CA (USA)). 10 Oct 1983. Contract FG03-81SF11608. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000351.

The Department of Energy awarded College of the Siskiyous a grant to provide a demonstration project that coordinated a variety of energy-related technologies: a 100-foot, two-podded solar greenhouse, a producer gas generator fired by wood chips, thermal storage devices (fish tanks, water filled drums, hydroponic reservoirs), and a group of related activities: alcohol fuels production with the carbon dioxide by-product being used in one pod of the greenhouse; growing small meat animals who would eat greens from the facility, would provide manure for the gardens, and would put off some heat for the facility; tank fish farming; an eleven acre appropriate technology homestead which would surround the greenhouse. At the time of this report, the greenhouse has been completed though devices (fans, stoves, louvers, shades)to minimize temperature shifts continue to be developed. The producer gas generator has had problems with tar buildup which gum up engines. Rather than running a motor off the unit to produce electricity for the greenhouse, the unit is being used to demonstrate how wood gasification can be used to run motors which in turn can be used to run generators, automobiles, etc. The facility is being used to experiment with a variety of growing periods, conditions, and materials.

843 **(PB—85-214567/XAB) Water and energy conservation through irrigation scheduling. Rept. for 1 July 1983-30 September 1984.** Bralts, V.F.; Loudon, T.L. (Michigan State Univ., East Lansing (USA). Dept. of Agricultural Engineering). 1984. 34p. NTIS, PC A03/MF A01.

Over the past five years, irrigated areas have increased substantially in Michigan and in other midwestern states. Existing water-balance models used for irrigation scheduling have been largely developed for application in the arid to semi-arid west. The procedures in these models for estimating evapotranspiration (ET) using crop coefficients, effective rainfall, and deep-percolation estimates were inadequate for application to areas with significant growing season rainfall. The overall goal of this research was to develop improved methods for scheduling the timing and amount of water used for irrigation in the more-humid areas of the midwest. To address the need for improved crop coefficients, a technique for using a portable chamber to measure actual ET in the field was developed and compared to ET measured by a weighing lysimeter. In addition, an interactive microcomputer program was developed that includes historic rainfall probabilities in irrigation-scheduling forecasts.

844 **(STU—81-5729) Modern open air drying. Literature survey. Final report.** Sandqvist, I. (National Swedish Board for Technical Development, Stockholm). Feb 1984. 33p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752732.

It has become interesting again to dry timber in the open air. It is above all the high energy costs that have led to a revival of open air drying, in spite of its high capital cost (interest on sawn goods that is drying) and an uncontrollable drying (the wind and the weather decide what the result will be). The open air drying is however, not of the old, classical type but of a modern variant where it is integrated with kiln drying for a certain part of the production and completed with some technical arrangements. The literature survey shows that for the last 30 years, different investigations have been carried out in Europe and in the USA in view of improving open air drying technically: by utilizing low-grade energy, by fanning and by an aerodynamic design of the timber yards. Open air drying in modern shape implies a halvening of the drying time in comparison with the classical open-air drying and modern open-air drying can therefore be financially interesting.

Studies that have been carried out during the last few years have also shown that this is the case and that is why some feasible development works intended for Swedish utilization are presented in the report.

845 **(TVA/ONRED/LER—85/47) Heat exchangers for lumber dry kilns.** Toennisson, R.L. (Tennessee Valley Authority, Norris (USA). Div. of Land and Economic Resources). May 1985. 39p. NTIS, PC A03/MF A01. File Number DE86900146.

An air-to-air, flat-plate heat exchanger was used to recover exhausted heat from an 80 MBF capacity commercial dry kiln. Heat exchanger efficiency averaged 46% and ranged from 20 to 90% on the charges studied. Energy consumption of the dry kiln was reduced by 18%. Natural gas savings at a cost of $5.65 per MCF were $1.76 per MBF for yellow-poplar and $4.70 for red oak. Estimated payback periods are: 1.05 years for oak and 1.15 years for yellow-poplar.

846 **Electric induction versus gas metal heating: A case study.** Salama, S.Y.; Desai, T.M. (Energy and Environmental Analysis, Inc.). pp 777-786 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

This paper compares the economics of using electric induction versus gas technologies for metal heating in forging applications. The importance of market factors, such as workpiece size, product-run, product quality, and energy price, to technology comparison is addressed. Market segmentation based on selected market factors is presented. A conventional slot furnace and an advanced rotary hearth furnace are selected to represent the range of gas furnaces. The total effective costs, including impacts on profitability due to factors such as material loss, are compared for the plant selected for the case study from the segment where induction is most competitive to gas technology. Slot furnace is found to be less cost-effective and rotary hearth is found to be competitive with respect to induction furnace. The impact on total effective cost of factors such as product-run (affecting furnace flexibility and automation), product quality, and energy price are examined. Energy, labor, and material loss, the three largest contributors to total effective costs are examined for possible new R & D activities to reduce their impacts and thus improve the economics of gas technology.

847 **High temperature heat wheel for industrial heat recovery.** Whitbeck, R.G.; Hemsath, K.H.; Prasad, A. (Energy Tech. Div., Midland-Ross Corp.). pp 866-875 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

A heat wheel system using a ceramic heat exchange matrix has been developed which can provide a means of significantly improving overall process thermal efficiency especially of high temperature processes. The unique design features of this heat wheel reduce inherent leakage, reduce maintenance problems, and expand temperature and pressure limits associated with existing heat wheel regenerators. A laboratory scale demonstration of the concept, supported by the Gas Research Institute, was completed in March, 1984 at the Midland-Ross Energy Technology Division Technical Center in Toledo, Ohio. The demonstration showed that the heat wheel performed at approximately 67% thermal effectiveness over the range of test conditions with acceptable, predictable rates of leakage, trouble-free mechanical performance, and provided a steady supply of high temperature, high pressure combustion air.

848 **Compact ceramic recuperator for industrial heat recovery.** Kleiner, R.N.; Coubrough, L.E.; Strasbaugh. (Coors Porcelain Co.). pp 855-865 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Metal industrial heat exchangers require costly over-temperature and dilution air controls in applications which operate over 1000\C (1832\F). Ceramic heat exchangers offer the advantage of not requiring these additional control systems but the ceramic units have been limited in durability in many of these applications. A new ceramic recuperator has been developed to overcome this imitation. The approach used in the design of this ceramic recuperator and the field test results are described.

849 **A ceramic finned-plate recuperator for industrial applications.** Coombs, M.; Strumpf, H.; Kotchick; Dobos, C. (AiResearch Manufacturing Co.). pp 846-854 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

High-level recuperation of high-temperature industrial furnaces offers an economically effective means for improving both process efficiency and fuel utilization. A ceramic recuperator capable of operating in flue gas temperatures of up to 1350\C and providing a combustion air preheat temperature of 1100\C can provide in excess of 50 percent savings in fuel consumption over an unrecuperated furnace. This recuperator consists of an array of cast ceramic finned plates. The fin geometries are such that when the plates are stacked together, they form the heat transfer flow passages for both the flue gas and combustion air streams. A reference design for an industrial recuperator system was created. The current development efforts conducted on this recuperator concept, as well as plans for future activities, are described.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 290, 1208

850 **(BFR-R—164-1984) Seasonal storage of heat in bedrock for district heating systems. Method study with applications in Borlaenge.** Emmelin, A.; Hyden, H.; Johnsson, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 89p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85752737.

The economy of different seasonal storage systems for heat has been studied for a district heating system with a base load of around 40 MW and with peakings near to 90 MW. A number of sources of waste- or reject heat might be available. Also available are locales for aquifer and for bedrock storage of heat. Calculations show that bedrock caverns are more expensive than boreholes, and that aquifier will be useful only in combination with heat pumps, and that this combination is capital-intensive. The possible feasible system is borehole storage which can be loaded up to 90 degrees C or more. Such a system will be inert, to be operational the boreholes have to be drilled from a tunnel system that also can be used for short-time heat delivery. Calculations have been performed on tunnel-borehole systems of capacities 29 and 40 GWh. The systems might be comparable to using oil, and would be more expensive than enlarging a heat pump system now in use (without storage).

851 **(DOE/R2/05063—T1) Montclair recycling. Final report, May 1, 1980-April 30, 1981.** (Montclair Dept. of Public Works, NJ (USA)). 15 Jun 1981. Contract FG42-79R205063. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000500.

With assistance from a Department of Energy Appropriate Technology Grant, Montclair Recycling added the curbside collection of color-mixed glass to an existing curbside newspaper collection program and installed intermediate processing equipment to upgrade the quality of the glass (i.e., color sort and remove metal contaminants) so it could be sold as a raw material to a nearby glass manufacturer. The first collection was made on May 1, 1980.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 765

852 **(CEER-X—208) Development plan: Center for Energy and Environment Research, University of Puerto Rico.** (Puerto Rico Univ., San Juan. Center for Energy and Environment Research). May 1985. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000061.

This document delineates the development plan for the Center for Energy and Environment Research (CEER) within the framework of the 1983 UPR Master Plan. The development plan, using the CEER mission as its point of departure, provides for the allocation of available human, technical and financial resources needed to achieve its mission and sets programmatic goals and priorities on short, intermediate and long terms. It also considers the overall and general budgetary requirements and identifies major funding sources. Since UPR funding support and the potential for competitive fund raising is limited, the plan stresses a program of high quality research within the context of service to Puerto Rico for problem oriented energy and environment research and development activities and leadership for education and technology transfer in the Caribbean Basin.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

853 **(AD-A—156773/4/XAB) 1984 CRC (Coordinating Research Council, Inc.) octane-number-requirement rating workshop.** (Coordinating Research Council, Inc., Atlanta, GA (USA)). Jun 1985. 43p. (CRC—542). NTIS, PC A03/MF A01.

An octane number requirement rating workshop was sponsored by the Coordinating Research Council May 7-11, 1984, in Phoenix, Arizona. The objective of the workshop was to improve the application of the CRC E-15 Technique for Determination of Octane Number Requirements of Light-Duty Vehicles to provide consistent results with vehicles equipped with knock sensors, turbochargers, and various transmission configurations such as torque converter lockups, four-speed overdrives, and five-speed manuals. Training was accomplished through seminars and demonstrations, and was verified with actual track testing using the E-15 rating technique and appropriate equipment.

854 **(DOE/CS/50006—2) Investigation of the effects of alternative fuel properties on combustion and emission mechanisms in direct injection engines.** Ng, H.; Borman, G. (Wisconsin Univ., Madison (USA)). Apr 1985. Contract AI01-81CS50006. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85017008.

Six different fuels were tested using a TACOM-LABECO modified single cylinder direct injection diesel engine with a four hole nozzle and a 24:1 compression. The six fuels tested were a blend of commercial diesel fuels Numbers 1 and 2 giving a cetane number of 43.3, JP-7 with only 2% aromatic content and a cetane number of 57.2, two bends of one-ring (benzene-ring) aromatic solvent and JP-7 giving cetanes of 31.3 and 41.7, and two bends of two-ring (naphthalene-ring) aromatics giving cetane numbers of 30.3 and 41.2 respectively. The two-ring aromatic blends gave 20 to 30% more particulates than the corresponding one-ring aromatic blends. A ratio pyrometer was used to obtain in-cylinder flame temperatures for five of the test fuels (excluding the diesel fuel blend). Results showed that the two-ring aromatic blends had a lower flame temperature at the beginning diffusion-burning period than the corresponding cetane number one-ring aromatic blends. Radiance data indicated that there were more in-cylinder particulates during that period in the two-ring than the one-ring blends. It was found that the lower cetane and one-ring blends had a larger fraction of homogeneous (premixed) burning than the higher cetane and two-ring blends respectively. Boosting the engine intake pressure to 125 kPa and fixing the fuel flow rate decreased exhaust particulate yield, but flame temperature was not affected significantly. There were more particulates present during the beginning of diffusion-burning in the naturally aspirated case than in the boosted case. Retarding the injection timing from 22° to 18° btdc at 1° CA intervals increased exhaust particulate yield while flame temperature decreased and in-cylinder particulates, during the beginning period of diffusion-burning, increased monotonically. 47 figs.

855 **(DOE/NASA/0167—9) Advanced gas turbine (AGT) technology development. Ninth semiannual progress report, January 1984-June 1984.** (Garrett Turbine Engine Co., Phoenix, AZ (USA)). Dec 1984. Contract AI01-77CS51040. 212p. (NASA-CR—174886). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86001478.

Project effort conducted under this contract is part of the DOE Gas Turbine Highway Vehicle System Program. This program is oriented at providing the United States automotive industry the high-risk long-range technology necessary to produce gas turbine engines for automobiles with reduced fuel consumption and reduced environmental impact. Technology resulting from this program is intended to reach the marketplace by the early 1990s. The major accomplishments for this period include: Power Section Development, Combustor Development, Regenerator, and Ceramic Development.

856 **(DOE/NASA/50194—43) Comparative evaluation of three alternative power cycles for waste heat recovery from the exhaust of adiabatic diesel engines.** Bailey, M.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1985. Contract AI01-80CS50194. 25p. (NASA-TM—86953). NTIS, PC A02/MF A01; GPO Dep. File Number DE85017352.

Three alternative power cycles were compared in application as an exhaust-gas heat-recovery system for use with advanced "adiabatic" diesel engines. The power cycle alternatives considered were steam Rankine, organic Rankine with RC-1 as the working fluid, and variations of an air Brayton cycle. The comparison was made in terms of fuel economy and economic payback potential for heavy-duty trucks operating in line-haul service. The results indicate that, in terms of engine rated specific fuel consumption, a diesel/alternative-power-cycle engine offers a significant improvement over the turbocompound diesel used as the baseline for comparison. The maximum improvement resulted from the use of a Rankine cycle heat-recovery system in series with turbocompounding. The air Brayton cycle alternatives studied, which included both simple-cycle and compression-intercooled configurations, were less effective and provided about half the fuel consumption improvement of the Rankine cycle alternatives under the same conditions. Capital and maintenance cost estimates were also developed for each of the heat-recovery power cycle systems. These costs were integrated with the fuel savings to identify the time required for net annual savings to pay back the initial capital investment. The sensitivity of capital payback time to arbitrary increases in fuel price, not accompanied by corresponding hardware cost inflation, was also examined. The results indicate that a fuel price increase is required for the alternative power cycles to pay back capital within an acceptable time period.

3302 External Combustion Engines

857 **(DOE/SF/11607—T1) Low grade heat conversion using bellowslike Stirling engines. Final technical report, November 1, 1981-September 15, 1983.** Raser, W.H. (Datatrace, Inc., Los Angeles, CA (USA). Stirling Experimental Div.). Sep 1983. Contract FG03-81SF11607. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000471.

The ultimate purpose is to develop a heat engine which is powered by low grade heat. The immediate objective of most of the present work is to design, fabricate, test and evaluate diaphragms which promise improvements including less friction, no leakage and longer life when compared to pistons in Stirling engines so that such engines are practical for low grade heat conversion. Among these diaphragms, the best performance was obtained by one which consisted simply of metal plates clamped to a rubber sheet. Although the worst performance was observed using a diaphragm of which most of the active area is free of any non-metal

sealing material, other factors make an evaluation of this feature inconclusive so far. Engine testing confirmed that diaphragm performance is significant.

3303 Electric-powered Systems

858 **(DOE/CS/54209—26) Variable-reluctance motor drives for electric vehicle propulsion. Final report.** Lang, J.H.; Vallese, F.J. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Electromagnetic and Electronic Systems). 1 May 1985. Contract AI01-78CS54209. 217p. (JPL—9950-1037). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85017585.

A methodology is presented for the design of a variable reluctance motor drive having high specific torque, power output and efficiency. Models are developed that describe the magnetic terminal relations of the VRM. These models are based on a flux-tube analysis that is motivated by numerically obtained finite-difference magnetic simulations. The result is a model for the flux-linkage/phase-current characteristic of the VRM. Intrinsic to this model is the estimation of maximum and minimum inductance as well the incremental inductance during bulk saturation. Also fundamental is the behavior of the flux linkage during local pole-tip saturation and due to bulk core saturation. This model agrees favorably with data available in the literature as well as experimental results presented in this thesis. The drive-oriented treatment of modelling and design uncovered important design interactions between the VRM, its inverter, and its excitation. The experimental 3.8-kW drive operated as expected, verifying the models and the design optimizations developed for VRM drives. These experimental results were projected to the 60-kW level, indicating that a 60-kW drive could be constructed with a VRM having a mass of approximately 65 kg, and an efficiency in excess of 95% at and below peak power output. The corresponding inverter was designed with only three high-power switches so as to reduce its cost.

859 **(DOE/CS/54209—27-Vol.2) Evaluation of semiconductor devices for electric and hybrid vehicle (EHV) ac-drive applications. Volume II. Final report.** Lee, F.C.; Chen, D.Y.; Jovanovic, M.; Hopkins, D.C. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Electrical Engineering). 1 May 1985. Contract AI01-78CS54209. 429p. (JPL—9950-1038-Vol.2). NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85017587.

This volume includes the following appendices: test data of switching times characterization of bipolar transistors, comparative test data of these times, test data of parallel operation of bipolar transistors, test data of RBSOA characterization, test data of MOSFETs on-resistance characterization, test data of MOSFETs switching times characterization, comparative test data of MOSFETs characterization, and test data of MOSFETs parallel operation characterization. (DLC)

860 **(DOE/CS/54209—28) Evaluation of half wave induction motor drive for use in passenger vehicles. Final report.** Hoft, R.G.; Kawamura, A.; Goodarzi, A.; Yang, G.Q.; Erickson, C.L. (Missouri Univ., Columbia (USA). Dept. of Electrical and Computer Engineering). 1 May 1985. Contract AI01-78CS54209. 243p. (JPL—9950-1039). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85017588.

This report describes research performed to devise and design a lower cost inverter-induction motor drive for electrical propulsion of passenger vehicles. A two-phase inverter-motor system is recommended. It is predicted to provide comparable vehicle performance, improved reliability and nearly a 10% cost advantage for a high production vehicle because of the reduction in total parts count, decreased total rating of the power semiconductor switches and somewhat simpler control hardware compared to the conventional three-phase bridge inverter-motor drive system. The major disadvantages of the two-phase inverter-motor drive are that the tow-phase motor is larger and more expensive than a three-phase machine, the design of snubbers for the power switches is difficult because motor lead and bifilar winding leakage inductances produce higher transient voltages, and the torque pulsations are relatively large because of the necessity to limit the inverter switching frequency to achieve high efficiency. An actuall model of the two-phase system must be constructed and evaluated. The most challenging engineering design task will be to design the inverter, motor and snubber circuits to minimize transient voltages with high system efficiency.

3307 Emission Control

861 **(TRW-SN—44134.000) Combustion phenomena in CI engines. Final report, 30 November 1984-20 August 1985.** Fendell, F. (TRW Space and Technology Group, Redondo Beach, CA (USA). Engineering Sciences Lab.). 1985. Contract AC04-84AL25994. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85016574.

TRW has initiated theoretical modeling and experimental measurement of soot formation and oxidation in a laminar counterflow apparatus, as a step toward the goal of evolving novel strategies for in-cylinder reduction of particle levels in diesel engines. A semiempirical approach is being adopted, whereby pointwise measurements of thermodynamic and dynamic fields in a one-dimensional flow can yield the soot source-sink (production-destruction) terms as a function of thermohydrodynamic parameters (fuel species, oxidizing species, inert species - including "additives," ambient temperature, pressure, etc.). A sequence of experiments is envisioned, whereby a gaseous fuel species is flowed against a hot inert stream, against a hot inert stream with oxides that can be reduced, and against air. A range of intrusive (sampling with gas chromatography, thermocouples, streak photography, etc.) and nonintrusive (laser-beam absorption and scattering) diagnostics are being evaluated for obtaining the soot number density, particle typical dimension, temperature, major-species concentrations, etc. The option of constructing an apparatus and utilizing the diagnostic facilities of the Combustion Research Facilities at the Sandia National Laboratories in Livermore, CA, is being explored. Until laboratory data are available, solution procedures for the theoretical model, which couples a conventional diffusion-flame analysis for the basic thermodynamic and dynamic fields with a kinetic-theory-type phase-plane analysis for the soot-related fields, are to be evolved and evaluated by processing of conceptual data. Finally, plans are being developed for validating the sooting model, derived from the one-dimensional counterflow investigation, by testing it against available data for two-dimensional diffusion flames.

3308 Alternative Fuels

862 **(ANL/EES-TM—289) Effects on minority and low-income households of the EPA proposal to reduce leaded gasoline use.** Rose, K.; LaBelle, S.; Winter, R.; Klein, Y. (Argonne National Lab., IL (USA)). Apr 1985. Contract W-31-109-ENG-38. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001873.

To reduce the potentially harmful environmental effects of lead in the environment, the US Environmental Protection Agency (EPA) has proposed a reduction in the amount of lead used in leaded gasoline. This report examines the potential impacts of such action on minority and low-income households in the US. The benefits of the EPA's proposal would presumably accrue primarily to households that contain small children and that are located in the central cities of metropolitan areas. This is because small children (under age seven) are particularly susceptible to the effects of lead and also because the automobile traffic density in central cities is higher than in any other area. Potential costs are examined in terms of households that own vehicles requiring leaded gasoline. Costs could accrue either because of higher gasoline prices due to reduced lead content or because of higher vehicle repair costs for engines that must use leaded gasoline to prevent excessive wear. Because of their location and number, minority and low-income households with small children would benefit more than the average US household. No costs would be incurred by the relatively large segment of minority and low-income households that own no vehicles. However, the Hispanic and other minority (except black) and low-income households that do own vehicles have a greater than average share of vehicles that require leaded gasoline; costs to

these households because of the EPA's proposed action would be comparatively high.

863 **(DOE/R0/00454—T1) [Dual fuel system on automobile for use of alcohol]. Final report.** Christofferson, J.E. (Christofferson (John E.), Idaho Falls, ID (USA)). 15 Feb 1982. Contract FG06-80R000454. 64p. (ID—80-001). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000452.

The dual fuel system utilized on the test vehicle supplies specific data to support the feasibility of low cost conversion from gasoline to alcohol as a primary fuel. Fuel efficiency increased as the proof of the alcohol was lowered (the proof was 160 minimum). The dual fuel system not only is a simple system to install, but it allows individuals to use alcohol of quality that is normally obtainable in the small "farm style stills." Alcohol from stills can be used directly as fuel in a converted fuel system in all climatic conditions. It was the intent of this study to evaluate the actual wear characteristics using gasoline as a primary fuel and the same engine using alcohol as a primary fuel. The major thrust of the study involved the oil analysis of gasoline and alcohol and the complete teardown and measure of the gasoline and alcohol engine after almost identical mileage and road conditions. The road conditions were "typical American driver" conditions rather than laboratory. The analysis indicates there is no significant increase of wear in an engine using alcohol as a primary fuel compared to the same engine using gasoline as the primary fuel. There is some deterioration of the carburetor components. The alcohol filters needed more frequent replacement. The ignition system had to be altered. Acceleration was less.

864 **(DOE/R2/05280—T1) [Conversion from gasoline to propane. Final report].** (Mount Olive, Township of, NJ (USA)). 23 Jan 1984. Contract FG42-81R205280. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85015632.

The engines use more propane than gasoline. The larger engines average 5.5 miles per gallon on propane while the average gasoline mileage was 7.5 per gallon. The engines run cleaner - spark plugs after 10,000 miles look like new - oil has not thinned out at 2500 miles and looks like it was changed recently. I find that the vehicles have more power with the propane and the engines do not ping. Maintenance on engines has declined, however, the starting sometimes is a problem. The timing of engines has to be perfect for the propane to work correctly and efficiently. Propane prices have increased and if one expects a savings in the purchase of fuel there is none. However the propane fumes are not toxic and the octane in propane is higher than in the gasoline.

865 **(STEV-BF—84-7) Production of alternative automotive fuels. Status report.** Brandberg, Aa.; Bertilsson, B.M.; Hedblom, A. (Statens Energiverk, Stockholm (Sweden)). Feb 1984. 208p. (In Swedish). NTIS (US Sales Only), PC A10/MF A01. File Number DE85752734.

The report is describing the technical development of processes for liquid automotive fuels. The state of the art concerning product specifications is stressed. Economic comparison of various processes has been performed and evaluated. A survey of atmospherical emissions is presented. The supporting data on pollution from new processes are still inadequate.

36 MATERIALS

REFER ALSO TO CITATION(S) 2, 16, 798

866 **(DOE/ER—0143/3) Materials Sciences Programs. Fiscal Year 1985.** (USDOE Office of Energy Research, Washington, DC. Materials Sciences Div.). Sep 1985. 258p. NTIS, PC A12/MF A01; GPO Dep. File Number DE86002089.

The purpose of this report is to provide a convenient compilation and index of the DOE Materials Sciences Division programs. This compilation is primarily intended for use by administrators, managers, and scientists to help coordinate research. The report is divided into six sections. Section A contains all Laboratory projects, Section B has all contract research projects, Section C has projects funded under the Small Business Innovation Research Program, Sections D and E have information on DOE collaborative research centers, Section F gives distribution of funding, and Section G has various indexes.

867 **(PNL—5536) Reduction in tribological energy losses in the transportation and electric utilities sectors.** Pinkus, O.; Wilcock, D.F.; Levinson, T.M. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 361p. NTIS, PC A16/MF A01; GPO Dep. File Number DE86000574.

This report is part of a study of ways and means of advancing the national energy conservation effort, particularly with regard to oil, via progress in the technology of tribology. The report is confined to two economic sectors: transportation, where the scope embraces primarily the highway fleets, and electric utilities. Together these two sectors account for half of the US energy consumption. Goal of the study is to ascertain the energy sinks attributable to tribological components and processes and to recommend long-range research and development (R & D) programs aimed at reducing these losses. In addition to the obvious tribological machine components such as bearings, piston rings, transmissions and so on, the study also extends to processes which are linked to tribology indirectly such as wear of machine parts, coatings of blades, high temperature materials leading to higher cycle efficiencies, attenuation of vibration, and other cycle improvements.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 30, 30, 32, 76, 457, 524, 564, 571, 846, 1066, 1131, 1776, 1794, 1879, 1910

868 (ANL—83-100-Pt.1, pp 106) **Optical properties and complex dielectric function of metallic aluminum from 0.04 to 10^4 eV.** Smith, D.Y.; Shiles, E.; Inokuti, M. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Measurements of the optical properties of metallic aluminum are reviewed and available data are analyzed to obtain the bulk values of the optical constants and the complex dielectric function from 0.04 eV to 10 keV. The intra- and interband contributions to the dielectric function are discussed briefly, and recently proposed values for the Drude parameters describing the intraband absorption are critically considered. Factors influencing experimental measurements are discussed, with emphasis on sample properties such as surface oxide layers, bulk inclusion of gases, surface roughness, and degree of crystallinity. The results of recent optical measurements are tabulated, along with recommended values of the optical properties resulting from a self-consistent Kramers-Kronig analysis of reflectance, transmission, and electron-energy-loss studies. The tabular data include the complex dielectric function, the complex index of refraction, and the reflectance and phase shift for normal incidence on a smooth, oxide-free surface. Detailed tabulations are given for the infrared, visible, and ultraviolet regions of the spectrum.

869 **(BNL—36943) Neutron scattering studies of heavy Fermions.** Shapiro, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 22p. (CONF-850871—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000628.

From International conference on neutron scattering; Santa Fe, NM, USA (19 Aug 1985).

Heavy Fermions are f electron materials characterized by a large linear term in the low temperature specific heat and a large magnetic susceptibility at low temperatures. This implies that there is a narrow peak in the f electron density of states at the Fermi energy. Typical examples are $CeAl_3$, UBe_{13}, $CeCu_2Si_2$, $CeCu_6$, U_2Zn_{17} and UPt_3. Neutron scattering measurements can play an important role in understanding the magnetic interactions in these systems. Measurements of the form reveal details about the nature of the wave functions. Inelastic scattering studies gives information

about the energy scale of the spin fluctuations and the narrow f-resonance. Such measurements on the above systems are reviewed with the goal of establishing systematics between the information obtained in neutron studies and that from bulk measurements.

870 **(BNL—37027) Characteristic length scales in gaseous hydrogen embrittlement.** Sieradzki, K.; McCoy, J.K.; Markworth, A.J.; Holbrook, J.H. (Brookhaven National Lab., Upton, NY (USA); Battelle Columbus Labs., OH (USA)). 1985. Contract AC02-76CH00016. 13p. (CONF-851125—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000629.

From American Society of Mechanical Engineers winter annual meeting; Miami, FL, USA (17 Nov 1985).

This paper presents an analysis which allows for an experimental determination of an upper bound to the characteristic length scale in a gaseous hydrogen embrittlement system. Our approach is based upon an ac analysis of the coupled adsorption diffusion equations for the hydrogen metal system. We show how the frequency of the driving pressure affects the depth below the surface at which surface and bulk processes effectively decouple from one another. This decoupling distance serves as a useful probe for the location of the so-called hydrogen embrittlement process zone.

871 **(BNL—37044) Magnetization and critical currents of NbTi wires with fine filaments.** Ghosh, A.K.; Sampson, W.B. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 8p. (CONF-850814—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001195.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

In high energy accelerators such as the SSC, the magnetization of the superconductor is an important component in determining the harmonic fields at injection (~0.3T). In an effort to reduce these residual fields, interest has focused on NbTi conductors with fine filaments which are expected to have a reduced magnetization as dictated by the critical state model. With this in view, the magnetization and critical currents were measured at 4.3K for a set of NbTi wires with filament diameters, d, ranging from 1.0 to 5.0 microns. The data show that, although the magnetization scales linearly with d, it does not do so with the product J/sub c/d for d less than 3 μm. However, at these d values, the critical transport current density, J/sub c/ of NbTi was observed to decrease rapidly as a function of d. The origin of this J/sub c/ degradation and its effect on the scaling of magnetization within the framework of the critical state model is explored. We also examine the question of the observed asymmetry of the hysteretic magnetization.

872 **(CEA-CONF—7696) Finite element determination of tearing modulus for application to industrial cases.** Charras, T.; Combescure, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1984. 9p. (CONF-841203—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752893.

From 6. international conference on fracture; New Delhi, India (4 Dec 1984).

The Tearing modulus, coming from a derivative of J with respect to crack-length is difficult to compute, specially in 3D, where computation costs are important. This paper presents a method to determine this value without doing two complete computations with two cracks lengths.

873 **(CEA-CONF—7697) Study of cladding toughness in a pressure vessel steel water reactor.** Soulat, P.; Al Mundheri, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1984. 8p. (CONF-841203—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752892.

From 6. international conference on fracture; New Delhi, India (4 Dec 1984).

Toughness of cladding and pressure vessel steel were determined at different temperatures in order to appreciate the participation of cladding resistance against crack propagation. The toughness of cladding is comparable with typical results on austenitic welds. The test on covered CT specimens shows the possibility of having a relatively good prevision of the behaviour of a coated structure.

874 **(CEA-R—5298) Microstructural evolution of metals and alloys under high temperature irradiation: a contribution.** Valentin, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-6 Univ., 75 (France)). Apr 1985. 119p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752839.

New techniques are proposed for describing yet poorly explored aspects of the microstructural evolution of metals under high temperature irradiation. Dislocation network: it is shown experimentally that the dislocation density is not uniquely defined by the irradiation flux and temperature. The proposed model where the dislocations climb, around fixed pinning points, due to interstitial capture, results in such an hysteresis. Coupling between the dislocation and void evolutions: the state of the microstructure is represented by a point in the appropriate space. The study of the singularities of the velocity field of this point reveals behaviors such as transient or heterogeneous swelling, which find here a simple explanation. Incubation for swelling as a result of solute redistribution: based on the atomistic theory of diffusion, a simple model is proposed for the dependance of the dislocation bias with the matrix solute content. This dependance is introduced in a simple model for swelling. The incubation dose which results exhibits several trends in agreement with published behaviors.

875 **(CONF-850887—38) Structural study of multilayered vanadium/nickel superlattices.** Homma, H.; Lepetre, Y.; Murduck, J.M.; Schuller, I.K.; Majkrzak, C.F. (Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA)). Jul 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02. File Number DE85018396.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

We have studied the microstructure of V/Ni metallic superlattice, using x-ray and neutron diffraction. We find a sharp and broad rocking curves around the first-order Bragg peak, and attribute them to a columnar structure which gives rise to two modulation structures; one the ordinary layered structure within the columns and the other the averaged modulation structure which produces the sharp rocking peak.

876 **(CONF-8511104—1) Some ways to modify the spinwave mode spectra of magnetic multilayers.** Gruenberg, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Jun 1985. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018412.

From Magnetism and magnetic materials conference; San Diego, CA, USA (27 Nov 1985).

Spin-wave modes in magnetic multilayers are of interest both for basic research and for application for example, in microwave devices. This paper discusses some ways to manipulate the mode-spectra of such multilayers. One way, for example, would be to have reversed magnetization direction in adjacent layers which can be achieved by tailoring the coercive forces of the films in a proper way. The case is discussed where the films are coupled by exchange as well as by the everpresent dipolar interaction. Here the amount of exchange can be tailored by choosing the proper materials or thickness for the nonmagnetic intermediate layers between the magnetic films. These effects have been studied for a couple of Fe sandwiches with intermediate layers of various materials and a short coupling length (≤ 5 A) was found for V and Cr, and a long one (≤ 20 A) for Cu, Ag, Au, and Pd. Taking pinhole effects into account this could be correlated with the different crystal structures but it could also be explained by charge transfer effects considering the electronegativities of these materials.

877 **(DOE/ER/10958—4) Detection of hydrogen assisted crack growth. Final report.** Carpenter, S.H. (Denver Univ., CO (USA). Dept. of Physics). Sep 1985. Contract AC02-81ER10958. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001881.

Changes in the elastic modulus of pure iron due to cracking produced by the cathodic charging have been measured and related to the density of cracking, the size of the cracks and the effective depth of cracking. The effects of experimental variables such as the vibratory strain amplitude, the charging current density sample size and mode of vibration have been determined. Effects of applied stress and test temperature have also been investigated. An added result of the modulus measurements has been the generation of complimentary internal friction data. The acoustic emission generated during the pressurization and subsequent pressure holds of small pressure vessels with a high pressure hydrogen and helium gas have been measured and characterized. The occurrence of cracking has been related to the production of measurable acoustic emission. To completely characterize the sources of measured acoustic emissions a variety of mechanical tests have been carried out. Double cantilever beam (DCB) specimens have been tested in different conditions to elucidate the acoustic emission from crack growth and to determine the effects of hydrogen environments.

878 **(DOE/ER/10958—T2) Study of hydrogen induced cracking in iron.** Armstrong, J.H. (Denver Univ., CO (USA)). Jun 1985. Contract AC02-81ER10958. 151p. NTIS, PC A08/MF A01; GPO Dep. File Number DE86002107.

Thesis.

The hydrogen-iron interaction during cathodic charging caused the initiation and growth of cracks, which resulted in the loss of modulus and an increase in internal friction. The loss of modulus (frequency) and the change in internal friction was found to be a two-part parallel exponential process. The strain amplitude-independent internal friction due to magnetic effects changed very little during cathodic charging. Current density has a great effect upon the kinetics and magnitude change for both the internal friction and resonant frequency of the first and second processes. Higher oscillatory strain amplitudes tend to pull the hydrogen away from the surface, accounting for lower frequency changes.

879 **(DOE/ER/45163—2) X-ray absorption spectrum of compressed copper.** Ingalls, R.; Crozier, E.D.; Seary, A.S. (Washington Univ., Seattle (USA). Dept. of Physics; Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Physics). 1985. Contract FG06-84ER45163. 9p. (CONF-850759—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000545.

From 10. high pressure conference on research in high pressure science and technology; Amsterdam, Netherlands (8 Jul 1985).

Recently a theoretical calculation of the x-ray absorption spectrum, XANES and EXAFS, versus pressure, has appeared for metallic copper. The theory agrees well with experiment at atmospheric pressure, and goes on to predict the response of the absorption spectrum to pressures corresponding to compressions as high as ten-fold. The authors also suggest copper to be a suitable pressure calibrant ("marker") for high pressure x-ray studies by using the pressure dependence of the EXAFS features, which are calculated to vary roughly as V/sup -2/3/, where V is the volume. Coincidentally, we have been using copper as pressure calibrant for x-ray absorption studies. However, we have determined the pressure by extracting the nearest neighbor bond compressibility from an analysis of the EXAFS. It should be recalled that because of the general difficulty with the ruby calibration method we have customarily used EXAFS determined bond lengths for pressure calibration. Other materials used for this purpose have been NaBr and RbCl [4,5]. It is the purpose of this note to briefly compare our results on copper with the theoretical work of Albers, et al. A much more detailed paper will describe the general suitability of copper as an EXAFS calibrant. 10 refs., 2 figs.

880 **(EPRI-NP—4272) Simulation of intergranular attack on Alloy 600 tubing in tubesheet crevices. Final report.** Krupowicz, J.J.; Scott, D.B. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Oct 1985. 174p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920020.

Each model boiler was preconditioned in All-Volatile Chemistry (AVT). One model boiler was then faulted with chemicals typical of a fresh-water condenser leak and simulated plant sludge. The other model boiler was first faulted with caustic, sodium carbonate, and sludge, then sodium carbonate and magnetite. Each model boiler contained seven tubes; tubing included Alloy 600 mill-annealed, cold-drawn, thermally-treated, and sensitized materials. Two different widths of tubesheet crevices were used. The fresh-water-faulted boiler experienced minor pitting and no significant IGA or IGSCC. The caustic-carbonate-faulted boilers experienced throughwall IGSCC and shallow IGA of mill-annealed and mill-annealed plus cold-drawn A600. Plastically deformed A800 (mill-annealed, cold-drawn glass bead peened) were susceptible to transgranular cracking in crevice regions. C-ring specimens in both boilers experienced no significant corrosion. Caustic denting of A508 tubesheets were observed.

881 **(FRNC-TH—1989) Investigations in thermal fields and stress fields induced by electron beam welding.** Basile, G. (Paris-6 Univ., 75 (France); Ecole Nationale Superieure des Arts et Metiers, 75 - Paris (France)). Dec 1979. 71p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752862.

This document presents the thermal study of electron beam welding and identifies stresses and strains from welding: description of the operating principles of the electron gun and characterization of various welding parameters, examination of the temperature fields during electron beam welding development of various mathematic models and comparison with experimental results, measurement and calculation of stresses and strains in the medium plane of the welding assembly, residual stresses analysis.

882 **(INIS-BR—295) Effect of the niobium additions in the passive films potentiostatically grown in a sulphate medium.** Kuri, S.E.; Martins, M.; D'Alkaine, C.V. (Sao Carlos Univ. (Brazil). Dept. de Engenharia de Materiais). 1984. 8p. (In Portuguese). (CONF-8405325—1). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780023.

From 11. national seminar on corrosion; Rio de Janeiro, Brazil (14 May 1984).

The stability of passive films potentiostatically grown on stainless steel electrodes was studied in a 2 N sulfuric acid. The effect of Niobium contents in the base metal was considered. The reactivation time was measured using the method of Potential Decay Measurements under Open-Circuit Conditions after electrochemical aging in the passivity region, and its influence on the surface oxidation states, was discussed. (Author).

883 **(INIS-BR—297) Stress corrosion in austenitic stainless steel tube of a heat exchanger.** Chaves, R.; Wolynec, S. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1984. 7p. (In Portuguese). (CONF-8405325—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780024.

From 11. national seminar on corrosion; Rio de Janeiro, Brazil (14 May 1984).

A case history of premature failure in a heat exchanger used to warm up the black liquor with water vapor in a pulp and paper plant is presented. Stress corrosion cracking did occur just after 48 hours of operation at the broaching region of AISI 304 stainless steel tubes. The cracks were initiated at the inner surface in contact with the black liquor. The stress corrosion was ascribed to high residual stresses introduced during broaching operation and to a strong alkaline environment at temperatures around 135°C. (Author)

884 **(INIS-BR—298) Effects of niobium addition on the structure and properties of medium and high carbon steels. Vol. 1,2.** Mei, P.R. (Universidade Estadual de Campinas (Brazil). Faculdade de Engenharia). 1983. 461p. (In Portuguese). NTIS (US Sales Only), PC A20/MF A01. File Number DE86780021.

An evaluation about the use of niobium in medium and high carbon steels, with ferritic-pearlitic structure, through the understanding of niobium actuaction mechanism in the structure, and consequently in the mechanical properties of those steels is done. (E.G.).

885 **(INIS-BR—301) Study of stress-reduction effects on creep behaviour of AISI-316 stainless steel.** Alegria, R.V. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1984. 100p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86780022.

Creep tests were performed in 316 austenitic stainless steel at 1006°K in both solution treated and in 15% pre-deformed samples. The dislocation substructure in the steady state stage was analysed for the applied stresses 109,30 MPa and 208,23 MPa. The influence of the prestraining conditions was verified. The strutural modifications occurring after a stress reduction were analysed in stress reduction tests. The results are discussed in terms of current ideas and its shown that the increase in creep resistance, introduced by a 15% pre-strain, is due to the presence of a subgrain structure and carbides which act as obstacles to dislocation motion. (E.G.).

886 (INIS-mf—9766, pp vp) **Formation of superconducting compounds by ion implantation and pulsed electron beam annealing.** Geerk, J.; Linker, G.; Meyer, O.; Friedland, E. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). 1983. NTIS (US Sales Only), PC A02/MF A01. File Number DE86780005. (CONF-8307157—Absts.).

From Symposium on ion implantation; Pretoria, South Africa (11 Jul 1983).

887 (INIS-mf—9766, pp vp) **Pulsed laser annealing of ion-implantation damage in silicon.** Pretorius, R.; Simpson, M.O. (Council for Scientific and Industrial Research, Faure, South Africa). 1983. NTIS (US Sales Only), PC A02/MF A01. File Number DE86780005. (CONF-8307157—Absts.).

From Symposium on ion implantation; Pretoria, South Africa (11 Jul 1983).

888 (INIS-mf—9766, pp vp) **Changes in ion-implantation profiles in silicon during pulsed laser irradiation.** Simpson, M.O.; Marais, D.J.; Pretorius, R. (Stellenbosch Univ., South Africa). 1983. NTIS (US Sales Only), PC A02/MF A01. File Number DE86780005. (CONF-8307157—Absts.).

From Symposium on ion implantation; Pretoria, South Africa (11 Jul 1983).

889 (INIS-mf—9910-Vol.2, pp 8-28) **Final analysis of the single phase erosion/corrosion test programme for reactor inlet feeders.** Kenchington, J.M. (Ontario Hydro, Toronto (Canada)); Pearson, B.M.; Murphy, E.V. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. CANDU Operations). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

The joint planning of a single phase erosion/corrosion test programme for inlet reactor feeders between Ontario Hydro and Atomic Energy of Canada Ltd. was commenced in 1979. The main reason for the programme was the potential to reduce the inlet feeder size. The resultant increase in feeder pressure loss would result in a critical power ratio improvement, obviate the need for inlet feeder flow restrictions and reduce the D_2O hold up. Specifically, the test programme was undertaken to assess erosion/corrosion in carbon steel piping over a range of velocities from 9.5 m/s to 38.1 m/s. This range straddles the present limiting design velocity of 16.8 m/s. It was also aimed at determining whether a threshold velocity exists above which erosion/corrosion of feeder piping and components becomes a concern. Further it was intended to identify any areas of localized attack and to see whether the various components such as reducers, orifices, bends, etc. have any effect on localized attack.

890 **(JINR—E-14-84-339) Moessbauer study of amorphous alloys irradiated with energetic heavy ions.** Kuzmann, E.; Spirov, I.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702730.

Submitted to the journal J. Nucl. Materials.

The Moessbauer spectroscopy was applied to study radiation damages in amorphous alloys irradiated with ^{40}Ar (E=225 MeV) or ^{132}Xe (E=120 MeV) ions at room temperature. In the magnetically split Moessbauer spectra the dose-dependent decreases of the intensity of the 2nd and 5th lines as well as of the average hyperfine magnetic field were observed. The changes were also analysed using the hyperfine field distribution obtained from the spectra. The results are interpreted in terms of defect creation and structural changes of short-range order of irradiated amorphous alloys.

891 **(LA-UR—85-3143) Superconductivity in the actinides.** Smith, J.L.; Lawson, A.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-8509147—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000786.

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

The trends in the occurrence of superconductivity in actinide materials are discussed. Most of them seem to show simple transition metal behavior. However, the superconductivity of americium proves that the f electrons are localized in that element and that "actinides" is the correct name for this row of elements. Recently the superconductivity of UBe_{13} and UPt_3 has been shown to be extremely unusual, and these compounds fall in the new class of compounds now known as heavy fermion materials.

892 **(LBL—20044) Application of the ANNNI model to long-period superstructures in some noble metal alloys.** de Fontaine, D.; Finel, A.; Takeda, S.; Kulik, J. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 15p. (CONF-850211—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000625.

From 114. AIME annual meeting (includes Society of Mining Engineers); New York, NY, USA (24 Feb 1985).

The phenomenon of long-period superstructures in ordered alloys is analyzed in terms of the ANNNI model. New ground state results are presented and applied to the case of one-dimensional periodic antiphase structures in Cu_3Pd. The difference between systems with diffuse antiphase domain boundaries (as in Cu_3Pd) and sharp boundaries (as in Ag_3Mg) is discussed and is argued to be due to the influence of the strength of the effective transverse pair interactions compared to that of the axial interactions along the long-period direction. Atomic resolution transmission electron micrographs are presented for Cu_3Pd and Ag_3Mg, which clearly illustrate the distinction.

893 (NBSIR—85-3025, pp 15-28) **Tensile and fracture properties of an Fe-14Mn-8Ni-1Mo-0.7C fully austenitic weld metal at 4 K.** Tobler, R.L.; Trevisan, R.E.; Reed, R.P. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

A fully austenitic steel butt weld 21 mm thick was produced by submerged arc welding using an experimental filler metal composition: Fe-14Mn-8Ni-1Mo-0.7C. The tensile and fracture properties of this weld were measured in liquid helium to evaluate its candidacy for applications at 4 K. The yield strength (1115 MPa) and toughness (K/sub IC/ congruent to 192 MPa x m1/2) combination of this material compares favorably with existing base metal properties for AISI 304 type alloys. A conventional ductile fracture consisting of void formation and coalescence was evidenced in both tensile fracture toughness specimens.

894 (NBSIR—85-3025, pp 29-44) **Predicting the toughness of SMA austenitic stainless steel welds at 77 K.** Siewert, T.A. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

Austenitic stainless steels often provide the best combination of strength and toughness for cryogenic applications: however, the weld toughness is frequently much lower than that of the base metal. This study proposes a more accurate and simpler model for developing improved filler metal compositions. Several previous studies of the weld toughness were analyzed separately and in combination using a stepwise regression method and an expanded variable list. The total data base consisted of chemical composition, fer-

rite number (FN), and the Charpy V-notch (CVN) toughness at 77 K of 79 austenitic stainless steel welds deposited by the shielded metal arc process. Analysis of the complete data base revealed that the FN calculated from the Schaeffler diagram was the most significant variable for predicting the CVN toughness. The predictive equation produced a better correlation between the measured and predicted values of weld toughness than the previously published predictive equations. The group of 36 fully austenitic welds and the group of 21 type 316 welds in the data base were analyzed by the same procedure. In both cases the ferrite number was found to be the most significant predictor of toughness.

895 (NBSIR—85-3025, pp 123-144) **Nickel and nitrogen alloying effects on the strength and toughness of austenitic stainless steels at 4 K.** Purtscher, P.T.; Reed, R.P. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

The tensile strength and fracture toughness at 4 K were studied as a function of Ni (6 to 15 wt %) and N (0.09 to 0.28 wt %) contents for eight austenitic stainless steels. Results indicate that N increases the tensile yield strength and decreases the fracture toughness, K/sub IC/(J). Nickel has little significant effect on tensile yield strength but increases the fracture toughness. The temperature dependence of the yield strength, σ/sub y/, follows the relationship σ/sub y/ = σ/sub o/e/sup -AT/ where σ/sub o/ is the yield strength at 0 K and A is the slope of ell n σ/sub y/ vs. T. The parameter A is proportional to the stacking fault energy. Nickel increases stacking fault energy and austenite stability. Lower Ni alloys exhibited brittle facets on fracture surfaces examined using scanning electron microscopy. The brittle facets are (111) austenite planes and are related to slip-band faulting. A new parameter called the quality index is presented and defined as the product σ/sub y/ K/sub IC/(J). This factor relates to the capacity of the alloy to achieve greater strength or toughness, but not at the expense of the other parameter. Nickel alloying is shown to increase the quality factor; N has little effect.

896 (NBSIR—85-3025, pp 145-150) **Low-temperature sound velocities in 304-type stainless steels: effect of interstitial C and N.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

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Between T = 293 and 4 K, we measured the longitudinal ultrasonic velocity of nine 304-type stainless steels with various C+N contents: 0.3 to 1.3 atomic percent. All alloys showed similar behavior: a regular increase in velocity down to approximately 100 K; below this, an anomalous decrease caused by a magnetic transition. The alloys varied in two ways: (1) contrary to some reports, increasing C+N decreases the Neel temperature strongly, approximately 13 K per atomic percent; (2) the magnitude of the low-temperature elastic softening associated with the Neel transition decreases slightly with increasing C+N content.

897 (NBSIR—85-3025, pp 151-165) **Linear-elastic fracture of high-nitrogen austenitic stainless steels at liquid helium temperature.** Tobler, R.L.; Reed, R.P.; Purtscher, P.T. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

Four Fe-Cr-Ni-Mn austenitic stainless steels containing 0.14, 0.26, 0.28, and 0.37 wt % N were fractured in a liquid helium environment at 4 K, and valid measurements of the linear-elastic plane-strain stress-intensity factor, K/sub Ic/, were obtained in most cases. Interstitial nitrogen significantly strengthens these steels at low temperatures so that relatively brittle fractures occur under plane-strain conditions at 4 K, despite the fact that these alloys are moderately ductile in uniaxial tension. The brittle failure mechanism at 4 K involves a form of cleavage or slip-band decohesion, as evidenced by the formation of transgranular facets on (111) crystallographic planes.

898 (NBSIR—85-3025, pp 181-192) **Notch tensile measurements and fracture toughness correlations for austenitic stainless steels.** Reed, R.P.; Tobler, R.L.; Read, D.T. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

Thirty-two alloys were included in a study of conventional notch tensile testing as a method of fracture toughness characterization for austenitic stainless steels at liquid helium temperature, 4 K. For the same austenitic stainless steels, tensile and J-integral fracture toughness (K/sub Ic/(J)) measurements have also been conducted. For these materials the notch tensile strength (σ/sub NTS) generally increases with yield strength (σ/sub y/), and the $\supset$/sub NTS//σ/sub y/ ratios are typically much greater than 1.0. Correlations between σ/sub NTS/, K/sub Ic/(J), and σ/sub y/ were assessed. The best data fit was found between the ratio, σ/NTS/K/sub Ic/(J), and the toughness, K/sub Ic/(J). Unfortunately, from this relation there is not uniqueness of K/sub Ic/ from σ/sub NTS/. Therefore at this time it is not considered practical to obtain estimates of K/sub Ic/ from notch tensile tests for austenitic steels at 4 K. However, one may compare the J-integral fracture toughness and cylindrical bar notch tensile measurements. There are three regions: (1) linear elastic (σ/sub NTS/ increases as K/sub Ic/(J) increases); (2) elastic-plastic (σ/sub NTS/ is essentially independent of K/sub Ic/(J); (3) plastic (σ/sub NTS/ decreases as K/sub Ic/(J) increases. The elastic-plastic (transition) region is associated with a plastic zone that extends completely through the notched cross-sectional area.

899 (NBSIR—85-3025, pp 193-205) **Elastic constants and instability in face-centered-cubic metals.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

For face-centered-cubic crystals, the single-crystal elastic constants, the C/sub ij/'s, reveal not only the well-known tendencies toward mechanical instability, but also another instability, which we call chemical. Besides considering the fcc elements, we consider also Fe-Ni alloys and Fe-Cr-Ni stainless steels. We suggest an interatomic-force-constant explanation of this instability.

900 (NBSIR—85-3025, pp 207-218) **Monocrystal-polycrystal elastic constants of a stainless steel.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

For a face-centered-cubic steel, we report new measurements of the monocrystal Voigt elastic-stiffness constants: C_{11}, C_{12}, C_{44}. The monocrystal steel, Fe-19Cr-1ONi, corresponds closely to the well-known AISI-304 austenitic stainless steel. Considering seven theories for the monocrystal-polycrystal elastic constants, we find the Hershey-Kroener-Eshelby theory agrees best with measurements. It predicts the shear modulus within 2% of observation, where the Voigt-Reuss first-order bounds differ by 49%. We review ten sets of Fe-Cr-Ni C/sub ij/ results and find that both Zener's elastic anisotropy and the C_{12}/C_{11} ratio are constant within 5%.

901 (NBSIR—85-3025, pp 219-227) **Elastic-constant anomalies at the Neel transition in Fe-18Cr-3Ni-13Mn.** Ledbetter, H.M.; Collings, E.W. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

Elastic constants of an 18Cr-3Ni-13Mn austenitic stainless steel were measured ultrasonically between room temperature and liquid-helium temperature. All the elastic constants change anomalously and reversibly near 191 K, which magnetic susceptibility measurements show to be the Neel (paramagnetic-to-antiferromagnetic) transition temperature.

902 (NBSIR—85-3025, pp 229-250) **Automatic near-threshold fatigue-crack growth-rate measurements at liquid helium temperature.** Tobler, R.L.; Cheng, Y.W. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

The development of a fully automated test apparatus for near-threshold fatigue crack growth rate measurements in a liquid helium environment is described, and some initial results for AISI 300 series stainless steels are presented. The experimental apparatus consists of a servohydraulic test machine and a cryostat, complete with minicomputer, programmable arbitrary waveform generator, programmable digital oscilloscope, and fully automatic liquid helium refill system. The technique uses 6.4-mm-thick compact specimens subjected to systematically decreasing loads, with 24-h operation at 40 Hz, the crack growth being continuously monitored by specimen compliance measurements. The results presented in this study include da/dN-versus-ΔK curves and threshold fatigue stress intensity factors, ΔK/sub th/, at 4 K for AISI 304L, 304LN, and 316 stainless steels. The near-threshold fatigue behaviors of these materials are similar, and the fatigue crack growth rate trends at intermediate ΔK levels nearly agree with published results.

903 (NBSIR—85-3025, pp 251-269) **Fatigue crack initiation from notches in austenitic stainless steels.** Tobler, R.L.; Shu, Q.S. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

Fatigue crack initiation from notches in austenitic stainless steels was studied for the first time using compact specimens of two common cryogenic alloys: AISI 316 and AISI 304L. The procedure is based on a fracture mechanics technique whereby ΔK rho/sub -1/2/, a parameter proportional to the change in maximum elastic stress at the notch root, is correlated with the cycles to initiate a 0.254-mm crack. The effects of some experimental variables including notch radius, stress level, specimen size, and test temperature (295, 76, and 4 K) are presented, and the fatigue crack initiation resistances of the AISI 316 and 304L austenitic steels are compared with martensitic and ferritic/pearlitic steel data at room temperature.

904 (NBSIR—85-3025, pp 271-294) **Stacking-fault energies in 304-type stainless steels: effects of interstitial carbon nitrogen.** Ledbetter, H.M.; Austin, M.W. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

Stacking-fault probability and stacking-fault energy were measured in 9 304-type stainless-steel alloys where C-plus-N content varied from 0.3 to 1.3 atomic percent. In one formulation of the problem, stacking-fault energy depends on four variables: stacking-fault probability, unit-cell size, (111)-direction Young's modulus, and dislocation density (or root-mean-square distortion strain). From powders, we determined stacking-fault probability by x-ray diffraction; we measured shifts of (111) and (200) diffraction peaks in both annealed-recrystallized and heavily deformed specimens. Obtaining the (111) Young modulus requires knowing the monocrystalline elastic constants, C/sub ij/, which we estimated from the polycrystalline elastic constants with a reverse Kroener method and an assumption about the C_{12}/C_{11} ratio. We determined the distortion strain from the relative deformation-induced broadening of the (111) and (222) diffraction peaks. With C-plus-N alloying, unit-cell size increases approximately 0.3%, the (111) Young modulus decreases approximately 0.5%, stacking-fault probability decreases approximately 6%, and distortion strain increases approximately 2%. The combined effects of these variable changes predict that stacking-fault energy increases approximately 10% per % interstitial C-plus-N content. Of the four variables, stacking-fault probability contributes most to the increase; for the zero-interstitial-content intercept, we found 0.016. For stacking-fault energy, we found a zero-solute intercept of 18 mJ/m^2. No difference appeared between effects of interstitial C and N. Peak-broadening showed that the effective size of the coherently diffracting domain decreased approximately 30% per % solute; the zero-solute intercept was 450 A.

905 (NBSIR—85-3025, pp 323-340) **Cryogenic steels for superconducting magnets: developments in Japan.** McHenry, H.I. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

The Japan Atomic Energy Research Institute initiated a program in 1982 to develop cryogenic steels for use in the large superconducting magnets planned for the Fusion Experimental Reactor. The target properties for the cryogenic steels are a yield strength of 1200 MPa at 4 K and a fracture toughness of 200 MPa $\sqrt{m}$ at 4 K. Progress on developing these steels was reviewed at a US/Japan workshop in December 1984. Five Japanese steel companies have developed candidate alloys that met or nearly met the property goals. The new steels include 25Cr-14Ni-4Mn, 12Ni-12Cr-10Mn-5Mo, 13Cr-5Ni-22Mn and 15Cr-1Ni-25Mn. All of the alloys are nonmagnetic, stainless steels that are alloyed with nitrogen (0.2 to 0.35%). Following the workshop, the participating steel companies were visited. This report summarizes the information about these new steels obtained at the workshop and during the visits.

906 (NUREG/CR—2317-Vol.1-No.4) **Container assessment: corrosion study of HLW container materials. Volume 1, No. 4. Quarterly progress report, October-December 1981.** Ahn, T.M.; Soo, P. (Brookhaven National Lab., Upton, NY (USA)). Apr 1982. Contract AC02-76CH00016. 43p. (BNL-NUREG—51449-Vol.1-No.4). NTIS, PC A03/MF A01 - GPO. File Number TI86000970.

Efforts in this quarter have been concentrated on the uniform and crevice corrosion, and hydrogen embrittlement of TiCode-12, which are considered to be potential corrosion failure modes in high-level waste container systems. The weight gain of TiCode-12 in WIPP Brine A is in good agreement with previous results from Sandia National Laboratory. The selective etching in weld heat-affected zones is considered to be responsible for the slower weight gain in the welded TiCode-12 and commercially pure (CP) titanium. The interaction of the oxide film with a salt compound precipated from the solution makes it difficult to correlate the weight gain with the thickness of the oxide film. The crevice corrosion of TiCode-12 in neutral brine solutions at 150°C has been identified by the observation of corrosion products and oxygen effects. The predominant oxide phase inside the crevice is TiO_2. In order to understand the mechanisms involved, crevice corrosion of CP titanium has also been studied. The effect of the oxidizer (produced by radiolysis) on the open circuit corrosion potential has been studied for TiCode-12 in WIPP Brine B. For a concentration of 33,000 ppM $HClO_3^-$, change in the potential has been observed, which is an indication of enhanced susceptibility to stress corrosion cracking in this material. Fractographic analysis of TiCode-12 and titanium in the study of internal hydrogen effects has been carried out using Scanning Electron Microscopy (SEM). Two types of cleavage occur as the strain rate is decreased or hydrogen level is increased. A limited amount of theoretical work has been performed on the construction of potential-pH diagrams for copper and lead at 100°C. Measurements have been made of the pressure build-up during gamma irradiation of brine and the gases generated were analyzed.

907 (NUREG/CR—2467) **Lower-bound K/sub Iscc/ values for bolting materials. A literature study.** Goldberg, A.; Juhas, M.C. (Lawrence Livermore National Lab., CA (USA)). 1 Oct 1981. Contract W-7405-ENG-48. 63p. (UCRL—53035). NTIS, PC A04/MF A01 - GPO. File Number TI86000931.

An extensive literature survey on stress-corrosion cracking of a variety of steels was made in response to the need by the US Nuclear Regulatory Commission (NRC) to establish lower-bound K/sub Iscc/ values for bolting type materials. Materials evaluated include the heat-treatable plain-carbon and Cr-Mo and Cr-Mo-Ni low-alloy steels, 17-4 PH and Custom 455 precipitation-hardening stainless steels, and the 18Ni-maraging steels. An exhaustive survey was made for water, aqueous chloride, and aqueous sulfide environ-

ments. We also report limited data on H_2S and H_2 gases, aqueous H_3BO_4, and atmospheric environments. The data are presented in the form of K/sub Iscc/ versus yield strength. The proposed NRC lower-bound K/sub Iscc/ curve for the low-alloy steels is consistent with the data reported for the various aqueous environments, but excluding the sulfides. The corresponding lower-bound curve based on reported data for 18Ni-maraging steels falls below that proposed by the NRC, especially at the high strength levels. The lower-bound curves for the precipiation-hardening stainless steels fall below the lower-bound curve for the maraging steels at the lower strength levels, but they merge at a yield strength of approximately 220 ksi. Reference is also made to crack-growth rate (CGR) and time to failure (t/sub f/). These two parameters frequently were found to vary differently from the corresponding K/sub Iscc/ values when examined as a function of material or environmental variables. The influence of various material and environmental factors on K/sub Iscc/, CGR, and t/sub f/ are discussed. 177 refs., 19 figs.

908 **(NUREG/CR—4379-Vol.1) Long-term performance of materials used for high-level waste packaging. First quarterly report: year four, April-June 1985. Volume 1.** Stahl, D.; Miller, N.E. (comps.). (Battelle Columbus Labs., OH (USA)). Sep 1985. 111p. NTIS, PC A06/MF A01 - GPO. File Number TI86900105.

As part of the Nuclear Regulatory Commission's requirement to assess the Department of Energy's application to construct geologic repositories for high-level radioactive waste, Battelle's Columbus Division is investigating the long-term performance of materials used for high-level waste packages. High-level waste glass studies are being concluded and efforts are being directed toward studying spent-fuel performance. The effects of devitrification on glass leach rates are being investigated, and silica dissolution was studied to provide data for the glass dissolution model. Preliminary data support this model. A glass leach test using organic acids was conducted, and leaching trends were observed. Real and simulated spent fuels are being incorporated in integral tests using simulated groundwater in a prototypic repository environment. The reactions of groundwater species with steels are being analyzed to evaluate susceptibility to pitting and stress-corrosion cracking. Potential cracking agents are being investigated by slow strain rate experiments. General and pitting corrosion models were further developed, based on known principles of mass transport and radiolytic production. A simplified groundwater-radiolysis model, developed for use with the corrosion models, was compared with other mechanisms for species concentration predictions. This report documents investigations performed during the period April 1985 through June 1985. 28 refs., 35 figs., 21 tabs.

909 **(ORNL—6206) Microstructure and mechanical properties of a 3 Cr-1.5 Mo steel.** Klueh, R.L.; Nasreldin, A.M. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002564.

Tensile and impact properties were determined for an alloy steel (3 wt % Cr-1.5 wt % Mo-0.1 wt % V-0.1 wt % C) considered a candidate for elevated-temperature pressure-vessel applications. The steel was tested in two heat-treated conditions: normalized and tempered and quenched and tempered. Mechanical properties were determined for various tempering conditions (time and temperature) as described by a tempering parameter. Similar tempering treatments for the quenched and the normalized steels led to similar strengths. However, for the lowest tempering parameter used, the impact properties for the quenched-and-tempered steel exceeded those for the normalized-and-tempered steel, resulting in an excellent ductile-brittle transition temperature (-70°C) and upper-shelf energy (225 J) for the quenched-and-tempered steel at a high strength (770 MPa ultimate tensile strength). Further tempering reduced the strength of the steel in both heat-treated conditions. The impact properties of the quenched steel were only slightly changed by further tempering, but those of the normalized steel improved, eventually equaling those of the quenched-and-tempered steel. Transmission electron microscopy showed that the quenched steel formed carbide-free acicular bainite and that the normalized steel formed granular bainite. The results indicate that properties might be optimized by proper heat treatment. 29 refs., 13 figs., 5 tabs.

910 **(ORNL/M—1) Shielded metal arc welding of carbon steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Mitchell, J.H. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001487.

Procedure WPS-101-ASME-2 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for shielded metal arc welding of carbon steels (P-Q1-1), in thickness range 0.125 to 0.75 inch; filler metal is E6010 (F-3, A-1).

911 **(ORNL/M—2) Gas tungsten arc welding of carbon steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Mitchell, J.H. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001488.

Procedure WPS-103-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of carbon steel (P-1-1), in thickness range 0.035 to 1.0 inch; filler metal is ER70S-3 (F-6, A-1); shielding gas is argon.

912 **(ORNL/M—4) Manual gas tungsten arc and semiautomatic gas metal arc welding of carbon steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001490.

Procedure WPS-107-ASME-1 is qualified under Section IX of the ASME Boiler and Vessel Code for manual gas tungsten arc and semiautomatic gas metal arc welding of carbon steel (P-1-1), in thickness range 0.237 to 2.0 inch; filler metal is ER70S-3 (F-6, A-1); shielding gas for GTAW is argon, and for GMAW is 95-5 argon-oxygen.

913 **(ORNL/M—5) Semiautomatic gas metal arc welding of carbon steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001491.

Procedure WPS-109-ASME-2 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for semiautomatic gas metal arc welding of carbon steel (P-1-1), in thickness range 0.187 to 2.0 inch; filler metal is ER70S-3 (F-6, A-1); shielding gas is 95-5 argon-oxygen.

914 **(ORNL/M—7) Low hydrogen shielded metal arc welding of carbon steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001493.

Procedure WPS-114-ASME-1 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for low hydrogen shielded metal arc welding of carbon steels (P-1-1), in thickness range 0.125 to 1.5 in.; filler metal is E7018 (F-4, A-1).

915 **(ORNL/M—8) Shielded metal arc welding of AISI 4340 alloy steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001494.

Procedure WPS-115 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for shielded metal arc welding of AISI 4340 alloy steel, in thickness range 0.187 to 2 inch; filler metal is E7018 (F-4, A-1).

916 **(ORNL/M—10) Gas tungsten arc and shielded metal arc welding of AISI 41XX steels. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001496.

Procedure WPS-127 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc and

shielded metal arc welding of AISI 4130 and 4142 steels (ASTM A519) (P-No: None), 0.438-in. wall pipe; filler metal is AMS 6457, Class 4130 MC (F-, A-No; None) (GTAW) and E8018-B2L (F-4, A-3) (GMAW); shielding gas is argon (GTAW).

917 **(ORNL/M—11) Gas tungsten arc and low hydrogen shielded metal arc welding of carbon steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001497.

Procedure WPS-128-ASME-1 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc and low hydrogen shielded metal arc welding of carbon steels (P-1-1), in thickness range 0.25 to 2 inch; filler metals are ER70S-3 (F-6, A-1) (GTAW) and E7018 (F-4, A-1); shielding gas is argon (GTAW).

918 **(ORNL/M—12) Shielded metal arc welding of chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Mitchell, J.H. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001498.

Procedure WPS-301-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for shielded metal arc welding of 300 Series Cr-Ni steels (P-8-1), in thickness range 0.125 to 2 inch; filler metal is E3XX-15 (F-5, A-8).

919 **(ORNL/M—13) Gas tungsten arc welding of chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001499.

Procedure WPS-302-ASME-13 is qualified under Section IX of the ASME Bolier and Pressure Vessel Code for gas tungsten arc welding of 300 series austenitic Cr-Ni stainless steels (P-8-1), in thickness range 0.020 to 1.75 in.; filler metal is ER300 series (F-6, A-8); shielding gas is argon.

920 **(ORNL/M—14) Gas tungsten arc and shielded metal arc welding of chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001500.

Procedure WPS-303-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc and shielded metal arc welding of 300 Series Cr-Ni steels (P-8-1), in thickness range 0.25 to 2 in.; filler metals are ER3XX (F-6, A-8) (GTAW) and E3XX-15 (F-5, A-8); shielding gas for GTAW is argon.

921 **(ORNL/M—15) Manual gas tungsten arc and semiautomatic gas metal arc welding of chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001501.

Procedure WPS-306-ASME-6 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for manual gas tungsten arc and semiautomatic gas metal arc welding of 300 Series Cr-Ni steels (P-8-1), in thickness range 0.375 to 2 inch; filler metal is ER3XX (F-6, A-8); shielding gases are argon (GTAW) and 98-2 argon-oxygen.

922 **(ORNL/M—17) Manual gas tungsten arc and machine gas metal arc welding of chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001503.

Procedure WPA-308-ASME-0 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for manual gas tungsten arc and machine gas metal arc welding of 300 Series Cr-Ni steels (P-8-1), in thickness range 0.375 to 2 inch; filler metal is ER3XX F-6,A-8); shielding gases are argon (GTAW) and 98-2 argon-oxygen (GMAW).

923 **(ORNL/M—18) Machine gas tungsten arc and machine gas metal arc welding of chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001504.

Procedure WPS-309-ASME-0 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for machine gas tungsten arc and machine gas metal arc welding of 300 Series Cr-Ni steels (P-8-1), in thickness range 0.375 to 2 inch; filler metal is ER3XX (F-6,A-8); shielding gases are argon (GTAW) and 98-2 argon-oxygen (GMAW).

924 **(ORNL/M—19) Gas tungsten arc welding of austenitic chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001505.

Procedure WPS-310 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of Type 309 and Type 310 austenitic stainless steels (P-8-2), in thickness range 0.029 to 0.625 inch; filler metals are ER309 (F-6, A-8) and ER310 (F-6, A-9), respectively; shielding gas is argon.

925 **(ORNL/M—20) Semiautomatic gas metal arc welding of chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001506.

Procedure WPS 315-ASME-1 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for semiautomatic gas metal arc welding of 300 Series Cr-Ni steels (P-8-1), in thickness range 0.25 to 1.0 in.; filler metal is ER3XX (F-6, A-8); shielding gas is 98-2 argon-oxygen.

926 **(ORNL/M—21) Machine gas tungsten arc welding of chromium nickel steels. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001507.

Procedure WPS-316-ASME-2 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for machine gas tungsten arc welding of 300 Series Cr-Ni steels (P-8-1), in thickness range 0.250 to 1.5 in.; filler metal is ER3XX (F-6,A-8); shielding gas is argon.

927 **(ORNL/M—23) Gas tungsten arc welding of aluminum alloys 3004, 5052, and 5X54. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001806.

Procedure WPS-1002 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of aluminum alloys 3004, 5052, 5154, and 5454 (P-22), in thickness range 0.062 to 0.5 in.; filler metal is ER4043 (F-23) for 3004, and ER5356 (F-22) for other alloys; shielding gas is argon.

928 **(ORNL/M—24) Gas tungsten arc welding of aluminum alloys 6XXX. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001510.

Procedure WPS-1003 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of aluminum alloys 6061 and 6063 (P-23), in thickness range

0.035 to 0.516 in.; filler metal is ER4043 (F-23) or ER5356 (F-22); shielding gas is argon.

929 **(ORNL/M—25) Gas tungsten arc dc welding of aluminum alloys 6XXX. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001511.

Procedure WPS-1007 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of aluminum alloys 6061 and 6063 (P-23), in thickness range 0.125 to 2.0 in.; filler metal is ER4043 (F-23); current is direct; shielding gas is helium.

930 **(ORNL/M—26) Manual gas tungsten arc (dc) and semiautomatic gas metal arc welding of 6XXX aluminum. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001512.

Procedure WPS-1009 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for manual gas tungsten arc (DC) and semiautomatic gas metal arc (DC) welding of aluminum alloys 6061 and 6063 (P-23), in thickness range 0.187 to 2 in.; filler metal is ER4043 (F-23); shielding gases are helium (GTAW) and argon (GMAW).

931 **(ORNL/M—27) Semiautomatic gas metal arc welding of 6XXX aluminum. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001513.

Precedure WPS-1015 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for semiautomatic gas metal arc welding of aluminum alloys 6061 and 6063 (P-23), in thickness 0.187 to 2.0 in.; filler metal is ER4043 (F-23); shielding gas is argon.

932 **(ORNL/M—28) Gas tungsten arc welding of copper. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001514.

procedure WPS-1101 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of copper alloys C10200, C10400, C10500, C10700, C12000, C12200 and C12300 (P-31), in thickness range 0.125 to 1.0 in.; filler metal is ERCu. (F-31); shielding gas is helium.

933 **(ORNL/M—29) Gas tungsten arc welding of nickel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001515.

Procedure WPS-1301-ASME-4 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel N02200 and N02201 (P-41), in thickness range 0.035 to 0.432 in.; filler metal is ERNi-1 (F-41); shielding gas is argon.

934 **(ORNL/M—30) Gas tungsten arc welding of nickel-copper. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001516.

Procedure WPS-1302-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel-copper N04400 (P-42), in thickness range 0.035 to 0.432 in.; filler metal is ERNiCu-7 (F-42); shielding gas is argon.

935 **(ORNL/M—32) Gas tungsten-arc welding of nickel-molybdenum or nickel-molybdenum-chromium (hastelloy-B and C). Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001518.

Procedure WPS-1401-ASME-2 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of 28 Mo-5Fe, 15.5 Cr-16Mo-3.5W and Low C-16 Mo-16 Cr-5.5Fe (P-44), in thickness range 0.035 to 0.432 in.; filler metals are respectively ERNiMo-1, ERNiCrMo-5 and NiCrMo-4 (F-44); shielding gas is argon.

936 **(ORNL/M—33) Gas tungsten arc welding of nickel-molybdenum-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001519.

Procedure WPS-1402-ASME-5 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel-molybdenum-chromium-iron, with or without 2% Ti, (P-44), in thickness range 0.042 to 2 in.; filler metal is ERNiMo-2 (F-44) or special alloy with 2% Ti; shielding gas is argon.

937 **(ORNL/M—35) Gas tungsten arc and shielded metal arc welding of carbon steel to chromium-nickel steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001521.

Procedure WPS-2103-ASME-1 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc and shielded metal arc welding of carbon steels (P-1-1) to 300 series Cr-Ni steels (P-8-1), in thickness range 0.25 to 2 in.; filler metals are ERNiCr-3 (F-43) (GTAW) and ENiCrFe-3 (F-43) (SMAW); shielding gas is argon (GTAW).

938 **(ORNL/M—36) Gas tungsten arc welding of chromium-nickel steel to chromium-molybdenum steel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001522.

Procedure WPS-2104-ASME-1 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of 300 series Cr-Ni steels (P-8-1) to 2-1/4-1Mo steels (P-5-1), in thickness range 0.187 to 1 in.; filler metal is ERNiCr-3 (F-43); shielding gas is argon.

939 **(ORNL/M—37) Gas tungsten arc welding of aluminum alloys 1XXX and 3003 to 3004, 5052 and 5X54. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001523.

Procedure WPS-2201 is qualified under Section IX of the ASME Boiler and Pressure Vessel for gas tungsten arc welding of aluminum alloys 1060, 1100, and 3003 (P-21) to 3004, 5052, 5154, and 5454 (P-22), in thickness range 0.062 to 0.5 in.; filler metal is ER5356 (F-22); shielding gas is argon.

940 **(ORNL/M—38) Gas tungsten arc welding of aluminum alloys 1XXX and 3003 to 6XXX. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001524.

Procedure WPS-2202 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of aluminum alloys 1060, 1100, and 3003 (P-21) to 6061 and 6063 (P-23), in thickness range 0.035 to 0.5 in.; filler metal is ER4043 (F-23); shielding gas is argon.

941 **(ORNL/M—39) Gas tungsten arc welding of aluminum alloys 3004, 5052, and 5X54 to 6XXX. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001525.

Procedure WPS-2203 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of aluminum alloys 3004, 5052, 5154, and 5454 (P-22) to 6061 and 6063 (P-23), in thickness range 0.062 to 0.5 inch; filler metal is ER4043 (F-23); shielding gas is argon.

942 **(ORNL/M—40) Gas tungsten arc (dc) welding of aluminum alloys 3004, 5052, and 5X54 to 6XXX. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001526.

Procedure WPS-2206 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of aluminum alloys 3004, 5052, 5154, and 5454 (P-22) to 6061 and 6063 (P-23), in thickness range 0.187 to 2.0 in.; filler metal is ER4043 (F-23); current is direct; shielding gas is helium.

943 **(ORNL/M—41) Gas tungsten arc (dc) welding of aluminum alloys 1XXX and 3003 to 6XXX. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001527.

Procedure WPS-2207 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of aluminum alloys 1060, 1100, and 3003 (P-21) to 6061 and 6063 (P-23), in thickness range 0.125 to 0.516; filler metal is ER4043 (F-23); current is direct; shielding gas is helium.

944 **(ORNL/M—42) Gas tungsten arc welding of nickel to nickel-copper. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001528.

Procedure WPS-2301-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel, N02200 or N02201 (P-41) to nickel-copper N04400 (P-42), in thickness range 0.035 to 0.432 in.; filler metal is ERNiCu-7 (F-42); shielding gas is argon.

945 **(ORNL/M—43) Gas tungsten arc welding of nickel to nickel-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001529.

Procedure WPS-2302-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel N02200 or N02201 (P-41) to nickel-chromium-iron N06600 (P-43), in thickness range 0.035 to 0.432 in.; filler metal is ERNiCrFe-5 (F-43); shielding gas is argon.

946 **(ORNL/M—44) Gas tungsten arc welding of nickel-copper to nickel-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001530.

Procedure WPS-2303-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel-copper N04400 (P-42) to nickel-chromium-iron N06600 (P-43), in thickness of 0.035 to 0.432 inch; filler metal is ERNiCu-7 (F-42); shielding gas is argon.

947 **(ORNL/M—45) Gas tungsten arc welding of nickel to nickel-molybdenum-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001531.

Procedure WPS-2304-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel N02200 or N02201 (P-41) to nickel-molybdenum-chromium-iron (P-44), in thicknes range 0.062 to 0.5 inch; filler metal is ERNiCr-3 (F-43); shielding gas is argon.

948 **(ORNL/M—46) Gas tungsten arc welding of nickel-chromium-iron to nickel-molybdenum-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunket, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001532.

Procedure WPS-2305-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of nickel-chromium-iron (P-43) to nickel-molybdenum-chromium-iron (P-44), in thickness range 0.062 to 0.5 in.; filler metal is ERNiCr-3 (F-43); shielding gas is argon.

949 **(ORNL/M—47) Gas tungsten arc welding of chromium-nickel steel to nickel. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001533.

Procedure WPS-2601-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding 300 series Cr-Ni steels (P-8-1) to nickel N02200 or N02201 (P-41), in thickness range 0.035 to 0.432; filler metal is ERNi-Cr-3 (F-43); shielding gas is argon.

950 **(ORNL/M—48) Gas tungsten arc welding of chromium-nickel steel to nickel-copper. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001534.

Procedure WPS-2602-ASME-3 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of 300 series Cr-Ni steels (P-8-1) to nickel-copper NO4400 (P-42), in thickness range 0.035 to 0.432 inch; filler metal is ERNiCu-7 (F-42); shielding gas is argon.

951 **(ORNL/M—49) Gas tungsten arc welding of chromium-nickel steel to nickel-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001535.

Procedure WPS-2603-ASME-6 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of 300 series Cr-Ni steels (P-8-1) to nickel-chromium-iron (P-43), in thickness range 0.020 to 0.432 in.; filler metal is ERNiCr-3 (F-43); shielding gas is argon.

952 **(ORNL/M—50) Gas tungsten arc welding of chromium-nickel steel to nickel-molybdenum-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R.; Plunkett, W.A. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001536.

Procedure WPS-2604-ASME-5 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of 300 series Cr-Ni steels (P-8-1) to nickel-molybdenum-chromium-iron (P-44), in thickness range 0.035 to 0.5 in.; filler metal is ERNiCr-3 (F-43); shielding gas is argon.

953 **(ORNL/M—51) Gas tungsten-arc welding of carbon steel to nickel-chromium-iron. Welding procedure specification.** Wodtke, C.H.; Frizzell, D.R. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001537.

Procedure WPS-2651-ASME-1 is qualified under Section IX of the ASME Boiler and Pressure Vessel Code for gas tungsten arc welding of carbon steel (P-1-1) to nickel-chromium-iron (P-43), in thickness range 0.125 to 0.432 in.; filler metal is ERNiCr-3 (F-43); shielding gas is argon.

954 **(PTB-FMBR—104) Inelastic neutron scattering using a crystal spectrometer on a pulsed source: Experimental tests of copper monochromators.** Carlile, C.; Williams, W.G.; Wagner, V. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Forschungs- und Messreaktor). Jan 1984. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752707.

Based on a previous report the discussion of an inelastic spectrometer using a crystal monochromator and time of flight analysis is pursued. The reflectivity of copper monochromator crystals has been investigated on the PTB reactor and the Harwell Linac pulsed source for neutron energies between 0.08 eV and 2 eV. Estimates are presented on the loss of reflectivity due to simultaneous reflections. Cooling the monochromator on the other hand enhances the reflectivity by up to a factor of 2. A spectrometer using a cooled vertically curved Cu (331) monochromator which gives the same resolution as the HET spectrometer on the SNS is predicted to give a flux at the scattering sample which is approximately three times lower at an incident energy proportional 1 eV. A more comparable performance of the crystal and copper spectrometers is expected at lower incident energies, and since the former offers improved background conditions and easier handling of the sample environment, we recommend extending this study to lower incident energies.

955 **(RFP—3877) Surface contamination on silver and its effects on cohesion in silver-silver solid state bonding.** Larson, D.T.; Roper, J.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001553.

Investigations concerning the effect of atmospheric surface contaminants on the cohesion of silver in the solid state bonding of metals were conducted. Surface contaminants found by Auger electron spectroscopy were chlorine, sulfur, oxygen, and carbon, with the major contaminant being carbon. Examination of the diffusion behavior of the surface contaminants at elevated temperatures showed that oxygen and carbon were stable at the bonding temperatures. Chlorine was removed from the surface at low temperatures (100°C), while sulfur reached a maximum surface concentration at 200°C and started to decrease as the temperature was further increased. Reduction of the carbon level by ultraviolet cleaning did not change the bond strengths at the bonding conditions of 20 ksi and 160°C. From these experiments, it was deduced that breaking through the contamination layer to provide intimate silver-silver contact is an important aspect of bonding.

956 **(SAND—85-1523C) Nd:YAG laser welding experiments.** Akau, R.L.; Keicher, D.M.; Fuerschbach, P.W.; Lienert, T.J. (Sandia National Labs., Albuquerque, NM (USA)). 1 Oct 1985. Contract AC04-76DP00789. 18p. (CONF-8510170—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000863.

From Laser welding and laser surface treatment clinic; Detroit, MI, USA (29 Oct 1985).

Laser-beam/plume interaction experiments were conducted with a pulsed Nd:YAG laser. A high speed camera was used to study plume growth phenomena and to determine maximum plume velocities. Tests were done on four different metals: Aluminum 1100, Molybdenum, Nickel 200, and Stainless Steel 304. Previous laser welding experiments have indicated that the vapor plume ejected from the irradiated base material significantly attenuates the laser beam energy for Nickel 200 and Stainless Steel 304. To substantiate this observation, the plume was subjected to a cross flow of argon gas. Metallurgical studies showed a significant increase in weld penetration for all materials except for Aluminum. These experiments also indicated that the plume ejects normal to the base material. Thus, the specimen was tilted at different angles in an attempt to reduce laser beam attenuation. Results showed no significant increase in weld depth when the tilt angle was increased. Mass loss measurements were also performed and the experimental data were an order-of-magnitude less than those predicted by a numerical laser welding code.

957 **(SAND—85-1688) Oxidation of uranium-.75 weight percent titanium in environments containing oxygen and/or water vapor at 140°C.** Greenholt, C.J. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86002093.

The alloy reacts with water vapor to form uranium dioxide and hydrogen with the reaction kinetics proportional to the water vapor pressure to the 1/2.1 power. U-0.75 Ti reacts with oxygen to form uranium dioxide. The reaction rate is linear and independent of the oxygen pressure between 0.5 and 1000 Torr and it was approximately 3.2 x 10^{-3}mg/cm^2.h. In a mixed environment of oxygen and water vapor, the alloy reacts preferentially with the oxygen and water vapor, the alloy reacts preferentially with the oxygen at a linear rate of approximately 3.3 x 10^{-3}mg/cm^2.h until the oxygen is depleted. After the oxygen is consumed, the reaction and kinetics change to those of the alloy/water reaction. The alloy behaves similarly to unalloyed uranium in all three environments, except that an initial region of water vapor/uranium reaction was observed for unalloyed uranium in the mixed environment which was not seen in the alloy studies. The alloy exhibits the same reaction rate pressure dependencies as unalloyed uranium; however, its reaction rates are one to two orders of magnitude slower than those of the unalloyed material. Because of its improved oxidation resistance, it may not be necessary to plate U-0.75Ti cor corrosion protection for use under specific environmental conditions.

958 **(UC/MSME—22279-12) Microstructural and micromechanical response in austenitic stainless steel overlays on low alloy steel plate. Final technical report, July 1, 1982-September 30, 1984.** Rosa, E.; Choi, P.; Moteff, J. (Cincinnati Univ., OH (USA). Dept. of Materials Science and Metallurgical Engineering). 10 Jun 1985. Contract AC05-84OR21400. 147p. NTIS, PC A07/MF A01; GPO Dep. File Number DE86002163.

E309/Modified 2-1/4Cr-1Mo, E347/Standard 2-1/4Cr-1Mo, and E347/E309/Standard 2-1/4Cr-1Mo weld overlays mechanical properties were investigated by microhardness means at room and elevated temperature. A method devised by Boeklen in Germany was employed to obtain the relative ductility from the indentation profile. Uniform elongations gathered from tensile tests performed at high temperatures showed a strong correlation with the ductility parameter obtained from indentations made on specimens of the same material of corresponding temperatures. Tabor's and Cahoon's models were employed and the ultimate tensile strength gathered from tensile tests performed at high temperature also showed a strong correlation with corrected values calculated from hot hardness indentations made at similar temperatures. The microindentations allowed point by point characterization of the several zones that compose the overlay weld. The characterization coupled to the methods employed in this investigation allows the assessment of both strength and uniform deformation parameters on localized areas. It has been shown that the technique used to deposit the welds on the base metal can substantially affect the weld response to plastic deformation. The point to point evaluation of the ductility parameter across the weld zone has shown that an oscillating pattern with a well defined period and amplitude is observed. Room temperature hardness evaluation after long time exposure to 1275°F (690°C) has shown that the weld and heat affected zones (HAZ) of the single layer material decreases with exposure time. In the double layer the bottom weld (E309) shows a hardness decrease, while the top weld (E347) shows a hardness increase. Calculation of the average ductility parameters over each zone has shown that the parameter for the HAZ decreases with increasing exposure times. 7 refs., 69 figs., 21 tabs.

959 **(UCRL—90188) Bonding dense Si_3N_4 components to steel for elevated-temperature cycling applications.** Landingham, R.L.; Shell, R.E. (Lawrence Livermore National Lab., CA (USA)). 27 Sep 1985. Contract W-7405-ENG-48. 18p. (CONF-8409117—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001577.

From 2. international conference on the science of hard materials; Rhodes, Greece (23 Sep 1984).

A ceramic-to-metal bond has been developed for dense Si_3N_4 and steel. The large thermal expansion mismatch was taken into account in the design of such bonds to prevent failure upon thermal cycling. Selection of bonding materials was restricted by the bonding temperature that would allow diffusion of such materials but would not overheat the steel. Previous bond developments had minimized such restrictions as expansion mismatch and bonding temperature by selecting a refractory metal (Mo) to be bonded directly to reaction-bonded Si_3N_4. Here, these temperature/expansion restrictions were minimized by going to a two-stage bonding technique.

960 **Creep-rupture characteristics of Type 304 stainless steel weldments with Type 308 stainless steel welds at 1100°F.** Manjoine, M.J. (Westinghouse Research and Development Center, Pittsburgh, Pennsylvania). *Welding Journal (Miami);* **64**: No. 6, 170S-179S(Jun 1985).

This paper describes the creep of Type 304 stainless steel plate weldments as influenced by the level of ferrite and the geometries of the Type 308 stainless steel weld metal. The method of testing enabled multiple determinations of the strains for weld metal, heat-affected zone (HAZ), and base metal at crack initiation and rupture. The tests of weldments included two levels of ferrite, 2 FN and 9 FN, and two weld geometries-75 deg V-groove weld and a single, square groove weld made from one side with a backing plate at the weld root. All tests were performed at 24 ksi (165 MPa) and 1100°F (593°C). The weldments with a central axial weld and constraints at the ends of the gage section were tensile loaded. Therefore, all zones of the weld are subjected to the same overall axial deformation. This loading and constraint is similar to a circumferential weld in a pipe or vessel. The failure mode was a function at all three of the following: The relative strengths and ductilities of the weld metal, heat-affected zone (HAZ) and the base metal. The residual stresses and deformations from the welding process. The stress and strain histories under loading.

961 **High temperature impression creep testing of weldments.** Gibbs, W.S.; Matlock, D.K.; Olson, D.L.; Wang, S.H. (Center for Welding Research, Department of Metallurgical Engineering, Colorado School of Mines, Golden, Colorado). *Welding Journal (Miami);* **64**: No. 6, 1535-1585(Jun 1985).

The impression creep test technique, a modified hot hardness test in which the time dependence of the indentor displacement correlates directly to creep properties, has been utilized to measure the localized creep properties across welded joints. High temperature creep data, as a function of position, with respect to the fusion line, were measured on an autogeneous GTA aluminum weld and on an austenitic stainless steel to ferritic steel dissimilar metal weldment. The creep resistance of the aluminum weld decreased with position on traversing from the solidified weld metal to the base metal, and the variation in creep resistance with position was shown to correlate directly to gradients in microstructure.

962 **Effects of SO_2 shielding gas additions on GTA weld shape.** Heiple, C.R.; Burgardt, P. (Rockwell International, Rocky Flats Plant, North American Space Operations, Golden, CO). *Welding Journal (Miami);* **64**: No. 6, 159S-162S(Jun 1985).

Substantial increases in GTA weld depth/width ratio resulted from small additions of sulfur dioxide (SO_2) to the torch shielding gas when welding two stainless steels. The improvement was demonstrated on both Types 304 and 21-6-9 austenitic stainless steels, but would be expected for iron-base alloys generally. The weld pool shape achieved was essentially independent of variations in both SO_2 content of the torch gas and base metal composition when SO_2 in the shielding gas was in the range of 500 to 1400 ppm. With 700 ppm SO_2 in the torch gas, less than 30 ppm sulfur was added to an autogenous weld bead. For alloys where this additional sulfur can be tolerated and appropriate measures can be taken to handle the toxic SO_2, this technique offers a promising way to improve GTA weld joint penetration while suppressing variable penetration.

963 **Primary dendrite spacing: Pt. II: experimental studies of Pb-Pd and Pb-Au alloys.** Mason, J.T.; Trivedi, R.; Verhoeven, J.D. (Ames Laboratory-USDOE, Ames, IA). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **15A**: No. 9, 1665-1676(Sep 1984).

Directional solidification experiments have been extended to Pb-Pd and Pb-Au alloys. The primary spacing, λ, has been determined over a wide range of temperature gradients, G, and solidification velocities, V. The dependence of the spacing on both G and V is found to undergo a transition as the values of V and G are lowered. The transition with G is not correlated with the dendritic to cellular transformation. However, the transition with V appears to correlate with duplex microstructures which are observed in the dendritic to cellular transition region.

964 **Local microstructural modification in dynamically consolidated metal powders.** Gourdin, W.H. (Lawrence Livermore National Laboratory, Livermore, CA). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **15A**: No. 9, 1653-1664(Sep 1984).

Powders of 4330V steel, aluminum-6 pct silicon, and copper have been dynamically consolidated under well-characterized conditions using shock waves. Different regions in the final microstructures correlate well with the shock conditions during compaction, demonstrating the importance of the shock history in determining the final microstructure. Martensite is observed to form locally at powder particle surfaces in compacts of 4330V steel, and interparticle melting and rapid resolidification are observed in compacts of aluminum-6 pct silicon. Microprobe analyses of locally melted regions in the aluminum alloy indicate a homogeneous distribution of 6 pct silicon, well above the maximum equilibrium solid solubility. Comparison with the structure of "splat caps" found in the starting powder, suggests that locally melted regions experience a cooling rate comparable to that obtained in splat quenching. The extent of martensite formation and local melting are in good agreement with current models for energy deposition at powder particle surfaces during consolidation. The general implications of the analysis and observations are discussed.

965 **Forced velocity pearlite in high purity Fe-C alloys: Pt. 1. Experimental.** Pearson, D.D.; Verhoeven, J.D. (United Technologies Research Center, East Hartford, CT). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **15A**: No. 6, 1037-1046(Jun 1984).

An experimental technique was developed to measure the interface temperature of directionally transformed pearlite. It was shown that the growth temperature of such forced velocity pearlite is the same as the growth temperature of isothermally formed pearlite which grows at the same velocities. It was also shown that forced velocity pearlite is kinetically limited to maximum growth rates of around 100 um per second. It was demonstrated that a small but significant fraction of prior austenite grain boundaries interferes with pearlite growth by halting the growth of the cementite lamellae. Velocity vs spacing data were found to fit an equation of the form V α S /sup -n/ with n = 2.07. Arguments are presented which indicate that previous literature values of n = 2.4 and 2.7 may be high due to experimental difficulties.

966 **Forced velocity pearlite in high purity Fe-C alloys: Pt. II. Theoretical.** Verhoeven, J.D.; Pearson, D.D. (Iowa State Univ., Ames, IA). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **15A**: No. 6, 1047-1054(Jun 1984).

The forced velocity pearlite data of Part I is compared to the Zener-Hillert treatment and shown to fit the volume diffusion model but requires a D value higher than that of the Wells' et al. data by a factor of 3 to 4. It is postulated that the high D value is due to a strain in the austenite phase at the growth front. It is found that inclusion of a mobility term, u, in the Zener-Hillert anal-

ysis requires a quadratic form, $V = u\Delta X^2$, in order to fit the data. Additional experiments have shown that the degenerate pearlite found at high growth velocities results from coarsening of fine pearlite as it cools from the growth front temperatures. Finally, some speculations are offered to explain the various interesting growth features of pearlite presented in Part I.

967 **Cyclic creep acceleration and retardation in polycrystalline copper tested at ambient temperature.** Lorenzo, F.; Laird, C. (Department of Materials Science and Engineering, University of Pennsylvania, Philadelphia, PA). *Acta Metallurgica;* 32: No. 5, 681-692(May 1984).

In order to understand the mechanisms of cyclic creep retardation and acceleration, tests in both static and cyclic creep have been made on copper polycrystals at ambient temperature. Cyclic retardation occurs at low stress and acceleration at high stress. An expression for the temperature dependence of the threshold stress for acceleration is offered. The dislocation structures of the cyclically-crept copper have also been explored both in the presence and absence of strain bursts, and as a function of stress amplitude and grain orientation. Cyclic creep acceleration is interpreted by cyclic softening process involving dislocations on secondary systems, and the role of point defects is discounted.

968 **Strain bursts in the cyclic creep of copper single crystals at ambient temperature.** Lorenzo, F.; Laird, C. (Department of Materials Science and Engineering, University of Pennsylvania, Philadelphia PA). *Acta Metallurgica;* 32: No. 5, 671-680(May 1984).

In order to understand the mechanism of strain bursts previously observed in polycrystalline metal tested in cyclic creep, studies have been carried out on single crystals, variously oriented Regular stage I and stage II creep were observed under pulsating tension and a saturated hysteresis loop developed during stage II creep. For stresses above a threshold of 35 MPa in maximum stress, strain bursts occurred frequently in the single crystals. The bursts proceeded through the crystals in the manner of Luders bands. Studies of the dislocation structure by TEM showed the bursts to be accompanied by very large increases in secondary dislocation densities and by the formation of cell structures. The strain bursts are interpreted by cyclic latent softening and dislocation avalanches originating from secondary-rich dislocation clusters. Cyclic creep acceleration is interpreted as a gentler and more widely pervading form of strain bursts.

969 **Effects of the constituents on the mechanical behavior of low carbon steels.** Kim, N.J.; Thomas, G. (Univ. of Wyoming, Laramie). *Scripta Metallurgica;* 18: No. 8, 817-820(1984). Contract AC03-76SF00098.

Various microstructural constituents were obtained in the present research by suitable control of alloy compositions and processing variables. The alloys used in this study were Fe/1.5Mn/0.06C and Fe/1.5Mn/0.06C/0.05Nb steels. These were hot rolled and directly quenched from the finish rolling temperature of 800°C. The as-hot-rolled Fe/1.5Mn/0.06C alloy was two-phase annealed at 835°C and directly quenched. Experimental details of thermal and thermo-mechanical treatments are described elsewhere. Round tensile specimens of 12.7 mm gauge length and 3.2 mm gauge diameter were used. Impact tests were done on the 3/4 subsize Charpy specimens in the longitudinal direction. The ductile-brittle transition temperature were taken at the temperature corresponding to the midpoint of the upper and lower shelf energies.

970 **Retardation of grain boundary self-diffusion in nickel doped with antimony and tin.** Padgett, R.A.; White, C.L. (Oak Ridge National Lab., TN). *Scripta Metallurgica;* 18: No. 5, 459-462(1984). Contract W-7405-ENG-26.

Many important metallurgical phenomena are strongly influenced or controlled by grain boundary mass transport. There is also much evidence that the composition of grain boundaries is often significantly different from the overall composition of metals and alloys, owing to strong segregation of residual (and often undetected) impurities. This segregation, which does not always advertise its presence through grain boundary brittleness, may vary markedly from heat to heat, and occasionally from specimen to specimen within a given heat. Unfortunately, there are relatively few experimental observations of how such segregation affects grain boundary mass transport, and even less fundamental understanding of how these effects occur. In this paper we present autoradiographic results on self-diffusion of ^{63}Ni in nickel and nickel doped with antimony and tin. While these results do not permit a quantitative evaluation of the grain boundary diffusivity, D, they qualitatively illustrate the dramatic effect that these solute elements have on the ability of nickel grain boundaries to act as preferential paths for mass transport.

971 **(LA-tr—85-45) Irreversibility of iron-nickel alloys.** Scheil, E. Translated from *Archiv fuer das Eisenhuettenwesen ;* 24: No. 3/4, 153-160(1953). Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001260.

The determination of the alpha + gamma equilibrium in iron-nickel alloys encounters difficulties which could only be overcome most recently by the use of a crutch and by expansion of the test times to years. Under standard conditions, no equilibrium sets in, because the transition sequence is not due to thermal space change of the atoms, but entirely or in part to athermal phenomena. For athermal transitions, two kinetically different processes occur; they are described with reference to the corresponding, also athermal processes of twin-peak and smooth plane formation, as Reversal or smooth transitions. A purely athermal conversion takes place without changes in composition. If no transition constrictions were present, then the transition could proceed at the same temperature during heating and cooling. The presence of constrictions is proven by the appearance of a hysteresis region, and in isothermal tests, by the retardation of the transition rate (smooth conversion) or by immediate cessation (reversal conversions). Mechanical stresses are the assumed cause of the constrictions. In the region of notable thermal space change, a conversion occurring at considerable speed is also observed in the hysteresis region. This transition is linked with changes in composition, which are greatest in the middle of the hysteresis region, but very small toward the boundaries of the region. This is explained by the fact that the constrictions drop off at the edges, so that the conversion can proceed so quickly that there is no time for a change in composition.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 20, 20, 142, 146, 797, 959, 1147, 1231

972 **(DOE/ID/12537—1) Development of laser drilling techniques to fabricate ceramic distributor plates. Phase I report, 15 August 1984-15 June 1985.** Polk, D.H. (United Technologies Research Center, East Hartford, CT (USA)). Aug 1985. Contract AC07-84ID12537. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86002297.

Fluidized bed heat exchangers (FBHEX) offer the potentially cost effective recovery of high temperature waste heat from the 2000 to 3000°F flue gases of many industrial processes. Such applications will require FBHEX distributor plates of ceramics that will withstand the high temperature and corrosive environment, and fabrication of the required perforated ceramic plates of 3 to 10% open area with holes as small as 0.01-in. in dia is not generally possible with conventional ceramic fabrication techniques. The objective of this Phase I program was to analytically and experimentally examine the technical and economic feasibility of laser drilling as a means for producing the required closely spaced arrays of small holes or slots in selected ceramics. Silicon carbide, silicon nitride, 85% alumina, and a SiC fiber composite were all successfully drilled with 3% open area arrays of 0.01-in. dia holes, 0.06-in. dia holes, and 0.01 x 0.06-in. slots and with no loss of strength except from section area reduction and stress concentrations. For potential mass production systems, drilling costs were estimated to be $120-620/ft^2. At least the lower costs appear economically viable, and improvements appear possible with further development of the drilling process. 11 refs., 17 figs., 10 tabs.

973 **(IS-T—1166) Synthesis and characterization of some reduced ternary and quaternary molybdenum oxide phases with strong metal-metal bonds.** Lii, K.H. (Ames Lab., IA (USA)). Oct 1985. Contract W-7405-ENG-82. 332p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE86002115.

In the course of our research on reduced ternary and quaternary molybdenum oxides, very interesting compounds with strong metal-metal bonds were discovered. Among these solid-state materials are found discrete cluster arrays and structures with extended metal-metal bonding. Further study in this system has revealed that many new structures exist in this new realm. The synthesis, structures, bonding, and properties of these new oxides, which are briefly summarized in tabular form, are presented in this thesis. 144 refs., 63 figs., 79 tabs.

974 **(LBL—20155) Pore size distribution during compaction and early stage sintering of Si_3N_4.** Naito, N. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 80p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001997.

Thesis.

Flaws such as the large cavities which may arise from non-uniform pore size distribution, grow and coalesce during sintering. These circumstances lead to isolated pores and exaggerated grain growth. This paper is devoted to achieving a more uniform pore size distribution for Si_3N_4 powders during compaction and early stage sintering. Some of the parameters that affect the structure of the green compact during die compaction are load, compaction rate, lubricant/binder characteristics and compact viscosity and relaxation behavior. Relationships of these parameters to pore size distribution were obtained. Specifically, a correlation was made with three predominant elements of the pore size distribution curves: the mean pore radius, the distribution around the mean pore radius and the existence of "tails" in the distribution curves which indicates the presence of larger pores in the powder compact. A more uniform pore size distribution curve was obtained through the use of viscous polymer binders. Powder rearrangement was promoted following compaction, by stress relaxation. Furthermore, there seemed to exist an optimal viscosity level for the polymer binder, a compromise between a narrow pore size distribution around the mean pore radius and a reduction in the number of larger pores. During the early stages sintering of the Si_3N_4 with Y_2O_3, a high percentage of transformation and minimal densification were observed; yet uniform green structures were maintained.

975 **(UCRL—92861) Explosive consolidation of aluminum nitride powder.** Wilkins, M.L.; Kusubov, A.S.; Cline, C.F. (Lawrence Livermore National Lab., CA (USA)). Jun 1985. Contract W-7405-ENG-48. 30p. (CONF-850770—12). NTIS, PC A03/MF A01; GPO Dep. File Number DE86001574.

From EXPLOMET '85 - international conference on metallurgical applications of shock wave and high strain-rate phenomena; Portland, OR, USA (28 Jul 1985).

Aluminum nitride is used as a model material for studying methods for the consolidation of high strength ceramics and metal alloys by dynamic compaction. Experiments coupled with computer simulations are used to explore fabrication techniques. The objective is to develop a methodology for manufacturing high strength material systems by dynamic compaction.

976 **Structure and magnetic properties of chromium(III) molybdate.** Battle, P.D.; Cheetham, A.K.; Harrison, W.T.A.; Pollard, N.J.; Faber, J. Jr. (Inorganic Chemistry and Chemical Crystallography Labs., Oxford, England). *Journal of Solid State Chemistry;* **58**: No. 2, 221-225(1 Jul 1985).

Magnetic susceptibility measurements have shown that $Cr_2(MoO_4)_3$ orders magnetically at 42 K. Powder neutron diffraction experiments at 295 and 5 K indicate that $Cr_2(MoO_4)_3$ is chemically and magnetically isostructural with the L-type ferrimagnet $Fe_2(MoO_4)_3$, and has a magnetic moment of 2.5 +/- 0.2 μ/sub B/ per cation at 5 K. The limitations imposed on powder neutron diffraction methods by particle-size effects are discussed. 12 references, 3 figures, 2 tables.

977 **Differentiation between ^{27}Al nuclei in alums by Fourier transform pure nuclear quadrupole resonance.** Zax, D.B.; Bielecki, A.; Sinton, S.W.; Pines, A. (Univ. of California, Berkeley). *Nature (London);* **312**: No. 5992, 351-352(22 Nov 1984). Contract AC03-76SF00098.

Aluminium is the most abundant metal in the Earth's lithosphere and is present in many commercially important materials. Recent studies on its role in zeolites and proposed solar energy storage schemes involving aluminium salts have led to renewed interest in analytical methods capable of identifying and characterizing specific crystalline sites. In particular, new techniques are necessary which do not require single crystals. One such technique is Fourier transform nuclear quadrupole resonance (NQR) with pulsed field cycling, and here is a report on its application to the determination of specific ^{27}Al sites in model aluminium compounds, the alums.

978 **Characterization of cracks subject to creep.** Blumenthal, W.; Evans, A.G. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 555-572 of Deformation of ceramic materials II. Tressler, R.E.; Bradt, R.C. New York, NY; Plenum Press (1984).

High temperature failure in alumina has been shown to involve the growth of cracks from microstructural heterogeneities. Similar processes accompany "shrinkage cracking" during sintering. The comprehension and prediction of crack growth and failure is thus contingent upon an ability to characterize and model crack growth rates. This paper describes the deformation response of small, semi-elliptical, indentation-induced surface cracks in fine-grain alumina monitored using crack opening and surface displacement measurements. Results indicate values of the secondary creep exponent between 1.5 and 2, and a temperature dependence consistent with creep data. However, at temperatures exceeding 1400 C, crack tip damage in the form of grain boundary cavities exerts a strong influence on the displacement field as predicted by recent theories. Use of the stress intensity factor as a loading parameter, based on Newtonian viscous behavior, does not produce adequate correlation with experimental results and is therefore unsuitable for non-linear creeping polycrystals

979 **Plastic flow of plasma sprayed ceramics.** Padovan, J.; Braun, M.J.; Chung, B.T.F.; Hendricks, R.C.; McDonald, G.; Mullen, R.L. (Univ. of Akron, Akron, OH). pp 472-485 of Deformation of ceramic materials II. Tressler, R.E.; Bradt, R.C. New York, NY; Plenum Press (1984).

Ceramics which are plasma sprayed onto metal substrates have a considerable potential application in gas turbine engines and other high temperature devices. However, there is disturbing evidence of expulsive shedding of the ceramic after cyclic heating to approximately 1000°C. This paper reports the results of experiments designed to measure the effect of tensile and compressive strain in the ceramic when at temperature in order to determine the cause of failure. Plastic flow was predicted and inelastic behavior measured for plasma sprayed binary oxide ceramics both on metal substrates and also when stripped from the substrate before exposure to temperature. Differential expansion between the metal substrate and plasma sprayed materials ZrO_2-Y_2O_3, ZrO_2-CaO or Al_2O_3-TiO_2 results in irreversible flow. Loading of the stripped binary oxide ceramic sheet materials at temperatures up to 1200°C also produced plastic flow, but annealing before loading eliminated the inelastic behavior. The conclusion is that plasma spraying of binary oxide ceramics results in a metastable state which is inelastic at temperature, but can also be stabilized or devitrified through heat treating, so as to decrease plastic properties. Stresses associated with sheet formation and component applications have been calculated. These studies point to significant inelastic behavior at elevated temperatures.

980 **Superplastic flow in ceramics enhanced by a liquid phase.** Raj, R.; Cyung, C.K.; Tsai, R.L.; Wang, J.F. (Cornell Univ., Ithaca, NY). pp 353-378 of Deformation of ceramic materials II. Tressler, R.E.; Bradt, R.C. New York, NY; Plenum Press (1984).

Grain boundaries are paths for rapid solid-state diffusion in most polycrystalline materials. If a liquid phase is segregated to the

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grain interfaces the diffusivity is further enhanced, provided that the crystal is soluble in the liquid. In stressed polycrystals the enhanced rate of mass transport can lead to unusually fast strain-rates, which may render ceramics amenable to superplastic forming. The authors show in this paper that in fine grained glass ceramic materials a nearly ideal superplastic behavior may be obtained, which is characterized by strain rate sensitivity of one. The ductility of these ceramics is found to be limited by the nucleation and growth of cavities at grain boundaries, or by the propagation of cracks from the surface in tensile testing. Tensile elongations greater than one hundred percent are nevertheless easily obtained. In addition to a description of the results from these experiments, a theoretical basis for predicting superplastic behavior in fine grained ceramics is developed.

3603 Composite Materials

981 **(BNL—36977) Sprayable electrically conductive polymer concrete coatings. Final report.** Fontana, J.J.; Reams, W.; Elling, D. (Brookhaven National Lab., Upton, NY (USA)). Jun 1985. Contract AC02-76CH00016. 30p. (FHWA/RD—85/095). NTIS, PC A03/MF A01. File Number TI86001624.

A sprayable electrically conductive polymer concrete coating for vertical and overhead applications has been developed. This technology, in conjunction with impressed current cathodic protection, can be used to prevent corrosion of the embedded reinforcing steel in concrete girders, piers, columns, and beams. A formulation of an electrically conductive polymer concrete, which holds the conductive filler in suspension and can be sprayed in thin uniform coatings, was developed. This coating is permeable, yet has low electrical resistivity, (<10 ohm-cm) good bond strength to concrete substrates, and good weatherability. The commercially available spray equipment can be used to spray mixtures containing up to 60 wt % calcined coke breeze and 40 wt % resin on vertical or overhead surfaces.

982 (NBSIR—85-3025, pp 49-86) **Mechanical-damage effects in woven laminates at low temperatures.** Kriz, R.D.; Muster, W.J. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

Large quantities of nonmetallic woven composites will be used in magnetic fusion energy structure at low temperatures. We predicted and measured the influence of crack formation on the mechanical performance of standard glass/epoxy laminates (G-10CR, G-11CR) at low temperatures. Mechanics of the load-deformation response of a unit cell of weave was predicted by a finite element model that assumes generalized plane strain. Damage was modeled as macrocracks confined to individual fiber bundles that were oriented transverse to the tensile load direction. From experiments with tension loads, we studied the formation of damage as a collection of fiber breaks, fiber bundle cracks, and delaminations between adjacent fiber bundles. Earlier experiments had shown that the strain to failure of the laminate increased when the components became brittle at low temperatures. We explain this behavior from results of our studies on the formation of damage in three-layer laminates of G-10CR and G-11CR at 76 K and 295 K: we measured fiber bundle cracks in the laminate interior and individual fiber fractures at the laminate edges by a replication technique. We discovered that the sequence and types of damage, at strains well below ultimate, control the discontinuities (knees) in the load-deformation (stress-strain) diagrams. However, between the knees, the material remains linear elastic at lower temperatures. We found that G-11CR has two knees and three distinct moduli; G-10CR has only two moduli and a single knee at a lower strain than G-11CR. Decrease in moduli measured near the knees compared well with predictions from the finite element model.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 837, 1086, 1087, 1091, 1212, 1245

983 (BNL—51847, pp 27-28) **Role of melting-recrystallization mechanism in deformation of crystalline polymers.** Wu, W.; Riekel, C.; Zachmann, H.G.; Koch, M.H.J. (National Bureau of Standards, Gaithersburg, MD). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

In order to better understand deformation of crystalline polymers, a study of the melting-recrystallization mechanism suggested to occur at the crystalline-amorphous interface was carried out. Polyethylene terphthalate (PET) was chosen for its convenient glass transition temperature, 70°C. Synchrotron radiation was used to investigate the rate of changes in the small-angle x-ray scattering (SAXS) patterns. The fully drawn PET yarns were stretched to ~10% tensile strain within milliseconds, and the strain was maintained throughout the test. Changes from a 4-point to a 2-point diagram was noted instantaneously in the SAXS pattern regardless of temperature, and the transition is reversible. It is concluded that probably a simple mechanical process rather than melting and recrystallization is the deformation mechanism.

984 (BNL—51847, pp 29-35) **Real-time studies of crazing processes in polymers.** Brown, H.R.; Mills, P.J.; Kramer, E.J. (IBM Research Lab., San Jose, CA). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Real-time small-angle X-ray scattering (SAXS) from polystyrene (PS) crazed in 3-point bending was investigated using intense X-ray radiation from the Cornell High Energy Synchrotron Source, CHESS. The SAXS patterns are recorded using a 2-D image intensifier/TV camera/video recorder system, operating at 30 frames/sec. Experiments were done using both monotonic and cyclic loading. In the latter case at the maximum of the load cycle, the SAXS pattern has a well defined streak normal to the craze fibrils. During the unloading portion of the cycle, however, the streak decreases in intensity and is spread into a diffuse fan. The loss of intensity is due to the decrease in volume of craze matter in the beam as the craze closes, while the spreading of the diffraction pattern is due to the disorientation of the craze fibrils as they buckle in response to compression by the surrounding polymer matrix. Whilst reloading of the sample causes a relatively narrow SAXS streak to reappear, the maximum load irreversible changes occur in the pattern from one cycle to the next. These changes are due both to an increase in craze fibril volume in the beam (craze growth) and to fibril breakdown and permanent disorientation. When the sample was loaded monotonically to failure it was observed that initially the pattern just increased in intensity with no change in shape, showing craze growth occurred at constant fibril structure. Later, as crack propagation started, the diffraction pattern fanned out, suggesting that the fibrils were compressed and disoriented on fracture induced unloading.

985 (BNL—51847, pp 36-44) **Glancing angle x-ray fluorescence method to study the concentration profile of a dissolved polymer near an interface.** Bloch, J.M.; Sansone, M.; Rondelez, F.; Peiffer, D.G.; Pincus, P.; Kim, M.W.; Eisenberger, P. (Brookhaven National Lab., Upton, NY). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

A new experimental method, the Near Total External Fluorescence (NTEF) method, for studying interfaces is described. The new method is based on the fact that the real part of the index of refraction vector n for matter is generally smaller than unity for electromagnetic radiation in the x-ray regime. The method allows for surface depth sensitivity an order of magnitude smaller than could be obtained by previous methods. The application of this new

method to the nondestructive study of the liquid-gas interface of monodispersed polystyrene dissolved in dimethyl sulfoxide is described.

988 (BNL—51847, pp 54-64) **EXAFS analysis of ion containing polymers.** Ding, Y.S.; Cooper, S.L. (Univ. of Wisconsin, Madison). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—). Contract AC02-81ER10922.

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The microstructural features of isonomers have been investigated using the combination of extended x-ray analysis absorption fine structure (EXAFS) and small-angle x-ray scattering (SAXS). For this work, the Zn and Rb K-edge x-ray absorption fine structure of these cations in various ionomer systems were measured and interpreted. A correlation between the nearest-neighbor Zn-O distance and coordination number was established from studies of reference compounds and was applied to the ionomer systems. In the dehydrated zinc neutralized ionomers, the zinc cation was found to be tetrahedrally coordinated to oxygen atoms. For ionomers with hydrocarbon backbones these oxygen atoms may originate from sulfonate or carboxylate groups. For ionomers with perfluorinated backbones some of the oxygen atoms may be ascribed to water coordination. The structural model of ion association of the sulfonated dry ionomers is different for the hydrocarbon and perfluorinated iomers. The dry carboxylate ionomers may be described by a zinc-propionate model with waters of hydration. In the fluorinated backbone ionomers the fully hydrated Zn neutralized ionomers contain the Zn $(H_2O)_6^{2+}$ species. The diffusional species is Zn $(H_2O)_6$ in the hydrated ionomer membranes just as it is in dilute aqueous solution. For monovalent rubidium neutralized ionomers, the nearest-neighbor cation environment is found to be highly disordered. It is clear that a wide variety of local structures can exist in different ionomers. However, all of these materials show evidence of ionic aggregation by small angle x-ray scattering. Therefore, it seems that the existence of a high degree of local structure in the environment of the cation is not vital for the formation of ionic aggregates. It may, however, be important in determining thermomechanical and electrochemical properties.

987 (BNL—51847, pp 65-72) **Ordering in ionic polymers.** Williams, C.E. (Universite Paris-Sud, Orsay, France). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Results of small-angle x-ray scattering (SAXS) and extended x-ray absorption fine structure (EXAFS) studies of halato-telechelic polymers based on polybutadiene or polyisoprene as model compounds for the more complex isomers are reported. These studies were used to investigate the morphology and long-range organization of the aggregates as a function of well-defined parameters such as nature of cation, length of the chain between ionic groups, degree of neutralization, effect of polar and non-polar solvents, and temperature. The reported data supported the concept of ionic multiplets in the ionomers, but no evidence was found to support the formation of clusters.

989 (BNL—51847, pp 85-93) **Study of the crystallization of an elastomer under strain at subambient temperatures.** Schultz, J.M. (Univ. of Delaware, Newark). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Small-angle x-ray scattering (SAXS) tests were carried out on rubber specimens. The SAXS instrument is described. A specimen-control system designed to sequentially stretch, upquench, heat-treat isothermally at subambient temperatures, downquench, and isothermally transform at subambient temperatures is described in detail. The effects of temperature were studied also. It is concluded that transformations in the rubber specimen are of the chemical growth type.

990 (BNL—51847, pp 94-104) **Response of polymer single crystals to a temperature jump close to the melting point.** Grubb, D.T.; Liu, J.J.H. (Cornell Univ., Ithaca, NY). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The Cornell High Energy Synchrotron Source (CHESS) has been used to obtain two dimensional X-ray scattering patterns from single crystal mats of high density polyethylene with a time resolution of 0.3s. A specimen thickness of only 0.02 mm allows a hot air blast to heat the specimen to annealing temperatures, T/sub a/, of 120-130°C within 1.0s. The SAXS peak spacing increases in a generally logarithmic fashion with annealing time, but the width and intensity vary in a more complex manner. SAXS intensity measurements has been used to follow crystallinity changes during annealing. It shows that melting and recrystallization does occur during the first minute of annealing at temperatures above 120°C. The recrystallization can be fitted by an Avrami plot with exponent n = 1, implying one dimensional growth. The recrystallization is much less dependent on T/sub a/ than would be expected from linear crystal growth rates.

990 (BNL—51847, pp 133-142) **Phase separation in low molecular weight polymer mixtures.** Russell, T.P.; Hadziioannou, G.; Warburton, W. (IBM Research Lab., San Jose, CA). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The phase separation of low molecular weight mixtures of polystyrene with polybutadiene was investigated by means of time resolved small-angle x-ray scattering at the Stanford Synchrotron Radiation Laboratory. A maximum in the scattering profiles was not observed within the resolution of the instrument (~80 nm) indicating that periodic fluctuations characteristic of a spinodal phase separation were much larger than the molecular dimensions and that the process is highly cooperative in nature. Deviations from the behavior predicted by linear theories was observed and can be attributed to either nonlinear effects or an additional contribution to the scattering arising from fluctuations in the density. A crossover point was, also, observed and was used to evaluate interaction parameter of the mixture. Finally, the equilibrium characteristics of the mixtures were examined as the temperature of the system approached the spinodal temperature. Agreement with the mean field theoretical predictions was found.

991 (BNL—51847, pp 143-151) **X-ray structure analysis of liquid crystalline copolyesters.** Blackwell, J.; Chivers, R.A.; Gutierrez, G.A. (Case Western Reserve Univ., Cleveland, OH). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The liquid crystalline state of the copolyester composed of 4-hydroxybenzoic acid (HBA) and 2-hydroxy-6-naphthoic acid (HNA) supplied by the Celanese Corp. has been examined. Results are reported for comonomer ratios between 80/20 and 20/80 mole% HBA/HNA including the minimum melting composition of 58/42. The x-ray patterns of the melt-spun fibers demonstrate a high degree of molecular orientation parallel to the fiber axis indicated by the shortness of the meridional arcs. The diffuse equatorial scatter at d $\approx$ 5 A points to imperfect lateral packing, but the presence of a few sharp (Bragg) equatorial and off-equatorial maxima requires the existence of some three-dimensional order.

3606 Other Materials

REFER ALSO TO CITATION(S) 187, 206, 208, 214, 304, 323, 837, 908, 1070, 1109, 1181, 1790

992 **(CEA-CONF—7525) Nuclear glass corrosion mechanisms applied to the French LWR reference glass.** Nogues, J.L.; Vernaz, E.Y.; Jacquet-Francillon, N. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). Nov 1984. 11p. (CONF-841157—91). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751942.

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The French LWR reference glass was leached under different experimental conditions. Analysis of the leachate together with electron microscopic examination of the leached surfaces led us to the following conclusions. The corrosion of the nuclear glasses is congruent at the hydration front, but only a fraction of the elements eneters the solution; the other elements contribute to the formation of the surface layer resulting in incongruent dissolution from the standpoint of the entire sample. The leaching rate in static experiments was observed to decrease sharply in time. Specific experiments were performed to assess the protective role of the hydrolyzed layer with respect to the silica solubility limit, and the predominant effect of the solubility limit was clearly demonstrated.

993 **(CEA-CONF—7526) Alterability of the French LWR solution reference glass in repository conditions.** Nogues, J.L.; Vernaz, E.Y.; Jacquet-Francillon, N.; Pasquini, S. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). Nov 1984. 11p. (CONF-841157—92). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751943.

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The disposal of glass blocks containing fission products in granitic geological formations is one of the options currently investigated in France. This paper discusses the major criteria selected to develop models of such repositories and gives the first results obtained with the corresponding experimental test. Five laboratory mockups corresponding to different alternatives regarding the fill materials were prepared. The following materials were used to encase the French LWR reference glass: - Test 1: granite, sand, stainless steel; Test 2: granite, sand, illite, stainless steel; - Test 3: granite, sand, bentonite, stainless steel; - Test 4: granite, sand, Al_2O_3, AZS, stainless steel; -Test 5: granite, sand, hastelloy C4. Samples were taken of the solutions obtained in the preconditioning cell and in contact with the glass to assess the glass corrosion behavior in each of these media. The experiments were completed by surface analyses designed to compare the morphology of the surface layers that develop with and without the environmental materials.

994 **(CONF-840764—8) High pressure x-ray absorption studies of phase transitions.** Tranquada, J.M.; Ingalls, R.; Crozier, E.D. (Washington Univ., Seattle (USA). Dept. of Physics; Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Physics). 1984. Contract AT06-83ER45038. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000548.

From 3. international EXAFS conference; Stanford, CA, USA (16 Jul 1984).

High pressure generally changes all of the properties of substances, leading to phase transitions in many cases. This paper reviews how such phase changes reveal themselves in x-ray absorption spectra. Examples are given using the salts NaBr, RbCl, CuBr, and SnSe. (DLC)

995 **(DESY—85-016) Radiation damage of CsI (Tl) crystals in a long term exposure at PETRA.** Schloegl, S.; Spitzer, H.; Wittenburg, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752713.

We have tested the radiation resistance of two 10 cm long CsI (Tl) crystals in the radiation environment of the PETRA e^+e^- storage ring. The crystals were exposed for 38 days to an average dose of 50 rad and 20 rad, respectively. The exposure lead to a continuous decrease of pulse height with a final reduction of 13 +- 1% (crystal 1 with photodiode readout at 50 rad) and 19.5 +- 2% (crystal 2 with photomultiplier readout at 20 adout at 20 rad). Most of the damage occurred in the first days of exposure. After the end of the exposure we observed a partial recovery of few percent.

996 **(DOE/EV/03861—50) Vacuum ultraviolet electronic properties of liquids. Annual progress report, February 1, 1985-January 31, 1986.** Painter, L.R. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). Sep 1985. Contract AS05-76EV03861. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001892.

Topics covered include collective oscillation in liquid silicone, electron emission, n-ethylene glycols, liquid water, and conductivity measurements. (GHT)

997 **(JINR—R-14-84-612) Investigation of phase transitions and vibrational spectrum of $CsHSO_4$ superionic conductor lattice using the neutron scattering method.** Belushkin, A.V.; Vonsitski, Ya.; Natkanets, I.; Plakida, N.M.; Shuvalov, L.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1984. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702726.

The results of elastic and inelastic neutron scattering studies on phase transitions and vibrational spectra in $CsHSO_4$(CHS) superionic conductor at the IBR-2 pulsed reactor are reported. It is shown that in the 123-420 K temperature range there are three phases (3-2-1) in CHS crystal and only two phases (2-1) in partially deuterated Cs(Dsub(0.7) Hsub(0.3) SOsub(4)) crystal. Effect of the deuteration, moisture of a sample, and of the temperature regime on the character of phase transitions is investigated. Basing on a considerable change in the vibrational spectra of the lattice at the superionic phase transition a conclusion is drawn as to the statistical disorder of protons in the lattice at phase 1.

998 (KIYI—83-2, pp 7-10) **Structure defects in InAs induced by ion implantation.** Gusev, O.K.; Kireenko, V.P.; Lomtev, A.A.; Yarzhembitskij, V.B. 1983. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780080.

In Investigation into the role of structure order in formation of surface and volume electron states.

Peculiarities of formation of n-type conductivity inversion layers on the surface of hole-type indium arsenide (p approximately 1.1×10^{17} cm^{-3}) induced by implantation of nitrogen ions, the latter being an electrically inactive impurity in the material, and (for comparison) of layers obtained using another way of defect generation - γ-irradiation, have been investigated. To evaluate the electron concentration in the surface inversion channel, the technique is used of analyzing the temperature of anomalous changes in the sign of the Hall constant, related to the presence of physical p-n transition in the near-surface region of p-InAs. The investigation of the effect of g-InAs surface state (preliminary etching in the mixture $HF:HNO_3:CH_3COOH$ = 1:3:1, etching in bromine-methyl solution) has shown the absence of the effect of surface perfection degree on the electric activity of defects, localized on it.

999 **(KIYI—83-2) Investigation into the role of structure order in formation of surface and volume electron states.** (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780080.

Separate abstracts were produced for individual papers for the Energy Data Base.

1000 (NBSIR—85-3025, pp 87-97) **Nonmetallic material standardization - materials and test methods.** Kasen, M.B. (National Bureau of Standards, Boulder, CO). May 1985. NTIS, PC A15/MF A01. File Number DE85014518.

In Materials studies for magnetic fusion energy applications at low temperatures. VIII. Technical reports.

The system for producing uniaxially reinforced, 3-4 mm diameter rod specimens described in the Sixth Annual Progress Report has been refined and validated by production of excellent quality specimens using liquid-mix epoxy resin systems. The methodology is undergoing further modification to permit use of hot-melt epoxy and polyimide resin systems as will be required for the experimental program to be conducted in the NLTNIF reactor at ORNL. Preliminary studies indicate that short beam and torsional shear test methods will be useful in evaluating radiation degradation. Development of these and other applicable test methods are continuing. A cooperative program established with laboratories in Japan and in England has resulted in the production and testing of specimens having an identical configuration. An effective interchange of laboratory data is continuing.

1001 (NUREG/CR—1863, pp 70, Appendix A) **Radiation effects on ion exchangers used in radioactive waste management. Appendix A.** Pillay, K.K.S. (Pennsylvania State Univ., University Park, PA). Jan 1981. NTIS, PC A06/MF A01 - GPO. File Number TI86000903.

In Properties of radioactive wastes and waste containers. Quarterly progress report, July-September 1980.

The status of present knowledge on the effects of ionizing radiations on ion exchangers was reexamined. This effort was initiated by the need to generate information on process related problems in the use of ion exchangers in radioactive waste management. Because of the limitations of available information, we have examined some of the problem potentials through a series of experiments. The results of these experiments conclusively demonstrate the when high specific activity wastes are embedded on ion exchangers, the radiolytic effects cause significant pH changes in the matrix causing accelerated corrosion and leakage of ionic species from the ion exchanger matrix. Other accompanying problems of gas evolution, pressure buildup, agglomeration and partitioning of liquids with leached out radionuclides and organics can be the root cause of a multitude of chemical hazards as well as process related problems for the long-term management of these wastes. An update of the extensive literature survey on the radiation effects on ion exchange material, (BNL-50781 undertaken in 1977) was attempted. Because of the rather limited nature of new information, the newly identified publications are simply listed to make the bibliography complete. 9 figs., 10 tabs.

1002 (NUREG/CR—2516-Vol.1-No.4) **Characterization of TMI-type wastes and solid products. Quarterly progress report, October-December 1981. Volume 1, No. 4.** Swyler, K.J.; Dayal, R. (Brookhaven National Lab., Upton, NY (USA)). Apr 1982. Contract AC02-76CH00016. 38p. (BNL-NUREG—51499-Vol.1-No.4). NTIS, PC A03/MF A01 - GPO. File Number TI86000964.

A research program is under way to systematically characterize the type of radwastes which may be generated in cleanup procedures following off-normal reactor operations. Specifically, the program is presently investigating how the properties of wastes containing ion-exchange media may be modified by heavy doses of irradiation from sorbed radionuclides. Special effort is being devoted towards quantifying the effects of factors such as radiation dose rate, chemical loading on the ion exchangers, moisture content and composition of external media, etc., which may influence the relation between laboratory test results and field performance. An extensive series of measurements has been initiated to investigate the effect of irradiation dose rate on radiation damage formation in IRN-77 resin. Samples are being irradiated at dose rates between approximately 1.7 x 10^6 and approximately 4 x 10^4 rad/h. Thus far, there is no evidence for a pronounced radiation-dose effect in the radiation-induced decomposition of (fully-swollen) IRN-77 resin. There is a substantial interaction between mild steel coupons and acidic species produced in the irradiation-induced decomposition of IRN-77 resin. For a given radiation dose, experiments at accelerated dose rates may tend to underestimate the net corrosion at low dose rates under field conditions. The corrosion behavior depends sensitively on resin loading - in some cases, long-term (or "asymptotic") corrosion rates may be much lower than initial rates. Substantial amounts of hydrogen gas can be generated in the corrosion of mild steel in IRN-77 resiin at the same time oxygen is unquestionably removed from the enviroment of irradiated resins. The scavenging does not rely on corrosion, and is quite effective at low dose rates and total doses. The O_2 scavenging may in part involve radiolytic conversion of O_2 and CO_2.

1003 (ORNL/Sub—79-42539/1) **Heat transfer characteristics of a normal-weight concrete wall. Final report.** Van Geem, M.G.; Fiorato, A.E.; Julien, J.T. (Construction Technology Labs., Skokie, IL (USA)). Feb 1983. Contract AC05-84OR21400. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001470.

Tests were conducted to evaluate thermal performance of three concrete walls. A normal-weight concrete wall, a structural lightweight concrete wall, and a low density concrete wall were tested in the calibrated hot box facility. This report covers experimental results for the normal-weight concrete wall. Test results for the lightweight structural concrete wall and low density concrete wall are covered in separate reports. The wall was subjected to steady-state, transient, and periodically varying temperature conditions. Steady-state tests were used to define heat transmission coefficients. Data obtained during transient and periodic temperature variations were used to define dynamic thermal response of the wall. Thus, effects of heat storage capacity could be evaluated. Conductivities derived from calibrated hot box tests were compared with results from hot wire tests. Hot wire tests were also used to evaluate the influence of moisture on thermal conductivity. Data obtained from dynamic tests were compared with steady-state calculations. Data obtained in this investigation are applicable to concrete wall assemblies commonly used in multi-family residential, commercial, and industrial structures. Results provide a data base for evaluation of building envelope performance in such structures, and are also applicable for defining thermal characteristics of concrete walls in passive solar systems. 23 refs., 34 figs., 19 tabs.

1004 (ORNL/TM—9539) **Amphibole ceramics: conceptual development and preliminary experiments.** Lauf, R.J. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001445.

Certain natural silicate minerals, commonly called jade, are well known for their resistance to brittle fracture. One type of jade, nephrite, is a compacted form of the amphibole mineral series tremolite-actinolite. Nephrite is tough because the naturally acicular crystal habit of these amphibole minerals produces an interwoven fibrous microstructure that impedes crack propagation. Object of this work was to duplicate the fibrous microstructure of nephrite by pulverizing natural tremolite or actinolite and then compacting it by hot pressing to form a dense body. Two other materials were also investigated, namely, clinochrysotile (serpentine asbestos) and synthetic fluor-tremolite. For each material, the milling characteristics and densification were studied. The resulting microstructures were characterized, and fracture toughness was measured for a limited number of samples. The most "fibrous" microstructure was obtained by hot pressing clinochrysotile 15 min a 1000°C. Actinolite, hot pressed 15 min at 1100°C, had a critical fracture toughness K/sub IC/ = 4.5 MPa m/sup 1/2/, which compares favorably with the toughness of nephrite jade (K/sub IC/ = 3.6). Decomposition of tremolite and actinolite to more stable phases occurred to some degree during hot pressing. Results suggest that hot isostatic pressing at high water vapor pressure should yield a dense product without causing amphibole decomposition. 28 figs., 7 tabs.

1005 (SAND—84-1188C) **Stability and growth of Lennard-Jones strained layer superlattice interfaces.** Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-851217—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012348.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

In the context of a model system whose atoms interact via Lennard-Jones (LJ) interatomic potentials, we have studied the stability of an initially perfect strained layer superlattice interface (SLS) and the process of growth of a mismatched layer on a substrate using Monte Carlo techniques. An initially perfect SLS interface is found to be metastable up to 12% mismatch, a much higher value than is found in real SLS systems. In contrast, we find that, within the limitations of the calculations, a perfect SLS interface

cannot be grown in an LJ system. The implications of these results for understanding SLS growth processes is discussed.

1006 **Electron paramagnetic resonance of Gd^{3+} in $ThBr_4$ single crystals at room temperature.** Hubert, S. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Emery, J.; Fayet, J.C. (Centre Universitaire du Mans, 72 (France). Lab. de Spectroscopie du Solide); Edelstein, N. (Lawrence Berkeley Lab., CA (USA)). *Solid State Communications;* **54**: No. 12, 1085-1090(Jun 1985).

The electron spin resonance spectra of trivalent gadolinium impurity in the tetragonal host crystal of $ThBr_4$ have been observed at X and Q band. The spectra show that Gd^{3+} occupy three types of sites: the Th^{4+} site which is tetragonal and two charge compensation sites corresponding to vacancies on the nearest neighbour nnVsub((Br^-)) and the next nearest neighbour nnnVsub((Br^-)). Spin Hamiltonian parameters have been determined for the tetragonal and the Gd^{3+} -nnnVsub((Br^-)) center. The implications of these results regarding the nature of the different sites are discussed.

1007 **Structure of nitromethane at pressures of 0.3 to 6.0 GPa.** Cromer, D.T. Ryan, R.R.; Schiferl, D. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **89**: No. 11, 2315-2318(23 May 1985).

Single crystals of nitromethane in diamond-anvil cells at pressures of 0.3 to 6.0 GPa have been studied by X-rays at room temperature. The crystal structure is similar to the low-temperature, ambient-pressure structure. Below 3.5 GPa hydrogen atoms could not be located. At 3.5 GPa the methyl group is rotated about 45° from the position in the low-temperature form. Raman data taken at pressures up to 11.7 GPa showed all molecular vibrational frequencies to increase with pressure. 15 references, 2 figures, 5 tables.

1008 **Phase transitions in nitrogen observed by Raman spectroscopy from 0.4 to 27.4 GPa at 15 K.** Schiferl, D.; Buchsbaum, S.; Mills, R.L. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **89**: No. 11, 2324-2330(23 May 1985).

Raman scattering from solid nitrogen was measured in a diamond-anvil cell from 0.4 to 27.4 GPa at a temperature of 15 K. Two new low-temperature structures, δ(LT1)-N_2 and δ(LT2)-N_2, were discovered through changes in the Raman spectra. Both structures bear a resemblance to the known high-temperature δ-N_2 phase, which has space group Pm3n. From a comprehensive study of correlation diagrams for related structures, likely space groups for the new phases were found. δ(LT1)-N_2, which forms from γ-N_2 at 1.9 GPa and is stable up to about 21.0-24.5 GPa, probably has structure R3c, in agreement with recent theoretical calculations. At higher pressures, δ(LT2)-N_2 exhibits a structure that is quite possibly R3c. 26 references, 4 figures, 7 tables.

1009 **Nature of unseeded crystallization in semiconductors.** Narayan, J. (Oak Ridge National Lab., TN). *Materials Letters;* **2**: No. 3, 219-222(Feb 1984). Contract W-7405-ENG-26.

The authors have studied crystal growth directions in explosively recrystallized ion-implanted amorphous silicon layers on silicon substrates (induced by continuous-wave Ar^+ laser or electron beam). Both these cases represented examples of unseeded crystallization in which the authors found (110) as the preferred direction of crystal growth. A crystallization model is presented to rationalize the predominance of (110) direction during unseeded crystal growth in semiconductors with a diamond cubic structure.

1010 **Mechanisms involved in the glow-discharge deposition of doped hydrogenated amorphous silicon.** Kampas, F.J.; Vanier, P.E. (Brookhaven National Lab., Upton, NY). *Journal of Non-Crystalline Solids;* **66**: 25-30(1984). Contract AC02-76CH00016.

It is shown that the dependence of the Fermi level on discharge phosphine concentration can be understood using a simple model of the doping process, in which charged dangling bonds during deposition are the precursors of all the dangling bonds in the deposited film.

40 CHEMISTRY

1011 **(DOE/ER—0144/3) Summaries of FY 1985 research in the chemical sciences.** (USDOE Office of Energy Research, Washington, DC. Chemical Sciences Div.). Sep 1985. 116p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85008925.

This publication includes 411 projects supported by both the Chemical Sciences budget and that portion of the Nuclear Sciences budget which is administered by the Division of Chemical Sciences. These computer generated summaries provide the scientific and technical public and interested persons in the legislative and executive branches of the Government a means for becoming acquainted with the Chemical Sciences program. Areas of research supported by the Division are: photochemical and radiation sciences; chemical physics; atomic physics; chemical energy conversions; separations and analysis; chemical engineering basics including thermodynamics and physical and chemical rate processes; isotope preparations; heavy element chemistry of the actinides, and support for operation of the Stanford Synchrotron Radiation Laboratory. Special facilities are described whose support allows the general scientific community access to unique and/or expensive equipment for research activities where no commercial laboratory exists. Individual contacts are provided. Indexes cover researchers and facilities. (PSB)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 39, 105, 143, 148, 151, 151, 151, 1067, 1136, 1148, 1229, 1267, 1270, 1360

1012 **(AD-A—155947/5/XAB) Radioisotope assay for 1-aminocyclopropane-1-carboxylic acid synthase: s-adenosylhomocysteine analogs as inhibitors of the enzyme involved in plant senescence.** Miura, G.A.; Chiang, P.K. (Walter Reed Army Inst. of Research, Washington, DC (USA)). 1985. 7p. NTIS, PC A02/MF A01.

A simple and rapid radioisotopic assay for 1-aminocyclopropane-1-carboxylic acid (ACC) synthase was developed, an enzyme involved in the biosynthesis of the plant hormone ethylene. The assay utilizes an AG50-X4(NH4 (+)) column which separates S-adenosyl-L-(carboxyl-^{14}C)methionine (AdoMet) from the product (^{14}C)acc, since the latter is not bound to the resin while (^{14}C)adoMet is. As opposed to other assays, this procedure measures ACC directly and does not require further conversion to ethylene. When an enzyme preparation from ripe-tomato fruits (Lycopersicon esculentum Mill) was assayed, an I_{50} of 2.5 + or - 0.8 micrometers for sinefungin and a K/sub m/ of 27 + or - 2 micrometers for AdoMet were obtained; these values were in good agreement with previous previous determinations made with a gas-chromatographic assay. When other nucleosides were tested as inhibitors the following order of decreasing activity was found: sinefungin, S-adenosylhomocysteine (AdoHcy), AdoHcy sulfoxide, S-n-butyladenosine, 3-deaza-adenosylhomocysteine, S-isobutyladenosine, S-isobutyladenosine, S-isobutyl-l-deazaadenosine. In contrast, S-isobutyl-3-deazaadenosine, S-isobutyl-7-deazaadenosine, 3-deazaadenosine, and adenodine were not inhibitory.

1013 **(ANL/EES-TM—287) Feasibility study: a portable high-performance liquid chromatograph for analysis of primary aromatic amines.** Vila, C.L. (Argonne National Lab., IL (USA)). Aug 1985. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001455.

The results of this work demonstrate the feasibility of constructing and operating a portable instrument for analysis of primary aromatic amines (PAAs) in air samples containing other organic chemicals. The proposed instrumentation would use amperometric (electrochemical) detection, which is both selective for and highly sensitive to PAAs, and high-performance liquid chromatography. Three mobile-phase systems amenable to electrochemical detection and capable of resolving PAAs were tested: methanol, acetonitrile, and propanol. The system used will depend on the nature of the sample to be analyzed. Because air samples cannot be introduced directly into such an instrument, a gas sample collector and

concentrator was designed. A preliminary set of experiments with a prototype concentrator system without a thermoelectric device using an air sample containing aniline resulted in 5 to 15% recovery. Additional work will be needed to improve the efficiency of the sample concentrator. 7 refs., 7 figs.

1014 (BNL—51847, pp 45-53) **Fluorescence measurements with a synchrotron source.** Moog, R.S.; Boxer, S.G. (Stanford Univ., CA). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Fluorescence measurements can be made by intercepting a fraction of a synchrotron beam. The instrumentation for accomplishing this at the Stanford Synchrotron Radiation Laboratory (SSRL) is described. A synthetic molecular system, the reconstitution of human semihemoglobins with two chlorophyllides, was selected to test the equipment in the determination of the orientation of the transition dipole moment for the lowest singlet excited state relative to the chlorophyll molecular frame and to investigate the effect of the protein environment on the excited transfer process.

1015 (BNL-NCS—36963) **New experimental techniques to be aware of.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-8508138—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001169.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

Some years ago, the Commission on Atomic Weights asked its Subcommittee on the Assessment of Isotopic Composition (SAIC), to keep it informed of new techniques that might eventually impact on its work. The Subcommittee never formally reported to the Commission because at the time, no techniques exceeded in accuracy that of thermionic emission mass spectrometry now in use to determine isotopic abundance values. This paper attempts to provide a status report on those other techniques in the field which may or may not eventually exceed the accuracy of thermionic emission mass spectrometry. This is merely an early warning system for the use of Commission members, who might not necessarily become aware of these other techniques in any other way. There are some general categories for these techniques and the author discusses very briefly the papers, which have been published over the years, in each of the categories. Those categories are gamma-ray and alpha spectrometry, activation analysis, laser techniques, infrared spectrometry, resonance ionization mass spectrometry, electron paramagnetic resonance (EPR) hyperfine structure techniques, emission spectrometry and ion microprobe mass spectrometry. 19 refs.

1016 (CEA-R—5299) **Contribution of photoelectron spectrometry and infrared spectrometry to the study of various oxidised forms of chromium.** Feve, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Rouen Univ., 76 - Mont-Saint-Aignan (France)). Mar 1985. 112p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752873.

Accurate knowledge of internal surface of primary coolant circuits of PWR is required for an estimation of dissolution of used materials and for estimation of decontamination efficiency. The binding energies of various electron levels of chromium were determined by photoelectron spectrometry (ESCA), both for the metal and for certain compounds. Because of the intensities of the signals obtained the 2 p 3/2 level alone can be used for analytical purposes. Owing to a possible interference between this level due to hexavalent chromium and a satellite peak caused by trivalent chromium the method is not able to show up small amounts of chromium VI in chromium III. Simultaneous detection of the hexavalent and trivalent forms was achieved by infrared spectrometry. The problem of revealing traces of chromium VI in surface layers of trivalent chromium oxide has thus been solved.

1017 (CEA-R—5300) **Laser induced spectrofluorometry of uranium.** Mauchien, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France)). Mar 1985. 218p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE85752840.

Time resolved spectrofluorometry is the most common method used for the determination of uranyl traces in solution. This element, when complexed in phosphoric medium has a fluorescence lifetime (100 us) very large compared to those of organic matters (<=5 ns) which create interferences in fluorometry without temporal resolution. Pulsed laser excitation and delayed fluorescence detection allow uranyl specific measurements. The apparatus made in our laboratory allows detection limit as low as 20 $ng.^{-1}$ (10^{-10}M).

1018 (CONF-840408—, pp 566-573) **Some uncertainties associated with self-calibration of microPIXE analysis.** Paschoa, A.S.; Wrenn, M.E.; Bruenger, F.W.; Cholewa, M.; Jones, K.W. (Univ. of Utah, Salt Lake City). Apr 1984. NTIS, PC A99/MF A01. File Number DE84017348.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

The technique of self-calibration, based on internal labelling of target samples with known amounts of a given element, is often used in conventional PIXE analysis of environmental and biological samples, usually when a large number of samples is to be analyzed. However, extreme care should be exercised when attempting to use self-calibration procedures for microPIXE analysis, because the microdistribution of the labelling element in a drop of solution, for example, is usually non-uniform, and particle microbeams with a homogeneous profile are difficult to obtain. The results of a series of scanning irradiations by a 20 μm proton beam across dried solution drops containing known initial concentrations of thorium which had been deposited onto two different backings are presented. Non-uniform distribution of thorium within the dried drops was observed.

1019 (CONF-840408—, pp 825-832) **Application of Szilard-Chalmers labelling for the determination of biomolecular association in aqueous solutions.** Rack, E.P.; Blotcky, A.J. (Univ. of Nebraska, Lincoln). Apr 1984. NTIS, PC A99/MF A01. File Number DE84017348.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

A radiometric recoil ^{130}I/sup m/ + ^{130}I atom tracer technique was developed for determining iodide ion-biomolecule association in liquid and frozen aqueous solutions of slightly soluble biomolecule solutes. It was found that the iodide ion associates with 5-iodouracil and 3-iodo-L-typrosine, but exhibits no association with uracil and 3,5-diiodo-L-tyrosine. 8 references, 1 table.

1020 (CONF-8509168—1) **Medium voltage analytical electron microscopy microanalysis versus radiation damage.** Zaluzec, N.J.; Mansfield, J.F.; Okamoto, P.R.; Lam, N.Q. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018463.

From Electron microscopy and analysis group conference; Newcastle-Upon-Tyne, England (2 Sep 1985).

The kinetic energy transferred to some elements by an electron of kinetic energy 100 to 400 kV is discussed. The displacement rates are compared to the signal generation. (DCL)

1021 (CONF-8509168—2) **Digital filters and their limitations in data analysis for electron energy loss spectroscopy.** Zaluzec, N.J.; Mansfield, J.F. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018464.

From Electron microscopy and analysis group conference; Newcastle-Upon-Tyne, England (2 Sep 1985).

It has been shown (Zaluzec, 1985) that the application of digital filters to EELS data can in many cases remove ambiguities

in the interpretation of EELS data by removing the judgemental nature of the background modeling step, particularly in situations of poor edge/background ratios. Using this technique to identify the presence or absence of an edge, independent of a background model, allows the analyst to employ without serious reservation more elaborate, yet operator-defined, background modeling routines to recover the relevant characteristic edge profiles. This paper briefly discusses the advantages and limitations of using these types of filters to spectral analysis of electron loss data in practical data analysis situations.

1022 **(CONF-8510151—6) Detecting isotopic ratio outliers.** Bayne, C.K.; Smith, D.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001335.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

An alternative method is proposed for improving isotopic ratio estimates. This method mathematically models pulse-count data and uses iterative reweighted Poisson regression to estimate model parameters to calculate the isotopic ratios. This computer-oriented approach provides theoretically better methods than conventional techniques to establish error limits and to identify outliers. 6 refs., 3 figs., 3 tabs.

1023 (DOE/PC/60015—30, pp 28, Appendix B) **Solvent composition effects in the normal-phase liquid chromatography of nitrogen heterocycles and hydroxyl aromatics on a nitrophenyl stationary phase.** Ruckmick, S.C.; Hurtubise, R.J. 9 Oct 1985. NTIS, PC A05/MF A01. File Number DE86001317.

In Separation and characterization of coal derived components, 1 July-30 September 1985.

The normal-phase liquid chromatographic model of Snyder (L.R. Snyder, in C. Horvath (Editor), "High Performance Liquid Chromatography," Vol. 3, Academic Press, New York, 1980, pp. 157-223) and Soczewinski (E. Soczewinski, Anal. Chem., 41 (1969) 179) was considered for a high performance Nucleosil NO_2 stationary phase. Various chloroform:n-heptane mobile phases were used to evaluate the ability of the Snyder-Soxzewinski model to approximately describe retention on the Nucleosil NO_2 column. It was found that log k' vs log mole fraction chloroform plots became less accurate for certain nitrogen heterocycle and hydroxyl aromatic solutes when a wide range of mobile phase compositions were considered. It was concluded that in most cases, retention behavior could be approximated for nitrogen and hydroxyl substituted aromatics by using plots of log k' vs log mole fraction chlorofom over a limited range of organic modifier concentrations. 35 refs., 4 figs., 4 tabs.

1024 **(GEPP-OP—895) Quantitative methods for the chemical analysis of sealing glasses.** Antepenko, R.J.; Carter, J.M.; Foster, J.C.; Palmer, D.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 1985. Contract AC04-76DP00656. 21p. (CONF-8504183—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001662.

From 7. General Electric (GE) company-wide materials characterization symposium; Schenectady, NY, USA (22 Apr 1985).

Sandia developed a high corrosion-resistant glass called TA-23 for application as the header sealing glass in lithium-sulfur dioxide (LAMB) cells. This glass contained a lower silica content and higher alumina content and was far more resistant to lithium electrolyte corrosion at the glass-to-metal seal. The glass functions as the electrical insulator and hermetic seal in the header. Chemical analysis methods were developed for quantitatively measuring the elemental composition of TA-23 glass, which has a nominal composition (wt %) of 45% SiO_2, 20% Al_2O_3, 8% B_2O_3, 12% CaO, 7% MgO, 6% SrO, 2% La_2O_3 and 0.05% CoO. Classical wet-chemical methods based on either gravimetric or volumetric procedures were used to measure silica and boric oxide. Instrumental techniques using atomic absorption spectrometry (AAS) and inductively coupled plasma (ICP) - atomic emission spectrometry were used to measure the remaining elements. The sample preparation and analysis procedures will be described for these methods. These methods have also been used to analyze other sealing glasses.

1025 **(INIS-BR—291) Mineralogical study of Brazilian fly ashes; origin, characteristics and quality.** Kihara, Y. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1984. 224p. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. File Number DE86780018.

Thirty-one fly ash samples from the five main Brazilian coal-powered thermoelectric plants were subjected to gravimetric chemical analysis, complexometry, flame photometry, X-ray diffractometry, thermodifferential and thermogravimetric analysis, transmitted and reflected light microscopy, electron microprobe analysis and transmited and scanning electron microscopy. (Author).

1026 (INIS-BR—308, pp 47) **Determination of beryllium in beryl by atomic absorption.** Gouvea, E.M. de (Companhia de Pesquisas de Recursos Minerais, Rio de Janeiro (Brazil)). 1984. (In Portuguese). NTIS (US Sales Only), PC A99/MF A01. File Number DE86780051. (CONF-8410271—Absts.).

From 16. Latin-American conference on chemistry; Rio de Janeiro, Brazil (14 Oct 1984).

Published in summary form only.

1027 **(INIS-mf—9742) 13th international symposium on autoradiography (13th ISA '83). Proceedings of the symposium.** Strba, J. (ed.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1983. 261p. (In Russian). (CONF-8305206—). NTIS (US Sales Only), PC A12/MF A01. File Number DE85781598.

From 13. international symposium on autoradiography; Tabor, Czechoslovakia (2 May 1983).

Selected papers have been processed for inclusion in the Energy Data Base.

1028 (INIS-mf—9910-Vol.1, pp 20-37) **Optogalvanic spectroscopy. A laser assisted technique for the analysis of special nuclear materials.** Pianarosa, P.; Demers, Y.; Gagne, J.M. (Ecole Polytechnique, Montreal, Quebec (Canada). Dept. de Genie Physique). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Laser induced optogalvanic spectroscopy in a hollow cathode-produced plasma has been used to resolve the isotopic structure of some absorption lines in uranium. We have shown that the optogalvanic signal associated with any isotope can be related to the concentration of that isotope in a multi-isotopic sample. From the results we have obtained, optogalvanic spectroscopy of sputtered samples appears to be an interesting approach to the isotopic analysis of both natural and enriched uranium and could easily be applied to the analysis of other fissile elements, such as the plutonium isotopes.

1029 **(LA-UR—85-3326) Analytical applications of ICP-FTS.** Faires, L.M.; Palmer, B.A.; Cunningham, P.T. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-8510151—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000819.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The Analytical Chemistry Group of the Chemistry Division at Los Alamos National Laboratory has been investigating the analytical utility of the inductively coupled plasma (ICP) - Fourier transform spectrometer (FTS) combination. While a new state-of-the-art FTS facility is under construction at Los Alamos, preliminary data have been obtained on the one-meter FTS at the National Solar Observatory at Kitt Peak, Arizona. This paper presents an update of the Los Alamos FTS facility, which is expected to be completed in 1986, and presents data showing the analytical potential of an ICP-FTS system. Some of the potential problems of the multiplex disadvantage are discussed, and the advantages of the high resolution obtainable with the FTS are illustrated. 7 refs., 5 figs.

1030 **(LA-UR—85-3444) Robotic sample preparation for radiochemical plutonium and americium analyses.** Stalnaker, N.; Beugelsdijk, T.; Thurston, A.; Quintana, J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-8510151—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000801.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A Zymate robotic system has been assembled and programmed to prepare samples for plutonium and americium analyses by radioactivity counting. The system performs two procedures: a simple dilution procedure and a TTA (xylene) extraction of plutonium. To perform the procedures, the robotic system executes 11 unit operations such as weighing, pipetting, mixing, etc. Approximately 150 programs, which require 64 kilobytes of memory, control the system. The system is now being tested with high-purity plutonium metal and plutonium oxide samples. Our studies indicate that the system can give results that agree within 5% at the 95% confidence level with determinations performed manually. 1 ref., 1 fig., 1 tab.

1031 **(OAEP—1-111) Determination of uranium by fluorometry.** Leenanupan, V.; Ratanalert, N. (Office of Atomic Energy for Peace, Bangkok (Thailand)). Aug 1984. 34p. (In Thai). NTIS (US Sales Only), PC A03/MF A01. File Number DE86780017.

The purpose of this work is to investigate the analytical parameters for the fluorometric determination of uranium applied in the analysis of geological materials. A mixture of 9 parts sodium fluoride, 45.5 parts sodium carbonate and 45.5 parts potassium carbonate was used as flux. The most suitable calibration range was found to be 0.01-0.40 microgram uranium and the detection limit of the fluorometer was 0.005 microgram. Interference for the quantitative analysis of uranium occured when the concentration of each element, Cr, Mn, Fe, Cu, Zn and Pb in the sample solution rised above 10 ug/ml. For separation of uranium from interfering elements, aluminium nitrate anneahydrate, as a saltingout agent and ethyl acetate, as an extractant were used. Various mixed acids for digestion were tested on standard ore NBL No.74-A. The mixture of sulphuric, hydrofluoric, nitric and perchloric in a ratio of 5:2:15:5 gave the most complete digestion. Three analytical methods, i.e. direct reading from calibration curve, standard addition and reading from calibration curve after solvent extraction were studied and compared. The results obtained by the method of standard addition was found to be most accurate. The relative standard deviation of replicate determinations of each method was about +-10%. 7 references.

1032 **(PNL-SA—13253) High-resolution cw resonance ionization mass spectrometry.** Whitaker, T.J.; Cannon, B.D.; Bushaw, B.A. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 7p. (CONF-8510151—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001674.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

We have used continuous-wave (cw) lasers to produce efficient, isotopically selective ionization of barium in the source region of a quadrupole mass spectrometer. The technique involves two low-power, high-resolution dye lasers for the resonance steps and a 100 watt cw Nd:YAG laser for photoionization. The use of cw lasers offers both better duty cycle and much better resolution than is possible with pulsed lasers. We have observed an isotopic selectivity of 800 between ^{137}Ba and ^{138}Ba in the cw resonance process. Ionization efficiency is estimated to be about 10^{-4} and simple improvements should improve this value to near unity. 7 refs., 3 figs.

1033 **(SAND—85-0738) Quantitative analysis of hydroxyl and boron in S glass-ceramic by Fourier transform infrared spectroscopy.** Oborny, M.C. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1985. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001148.

Fourier transform infrared (FT-ir) spectroscopy has been used to analyze hydroxyl and boron content in samples of S glass-ceramic, which is used in making glass-to-metal seals in the MC3753 actuator. Hydroxyl and boron concentrations in S glass-ceramic have a large effect on the final properties of the glass-ceramic. Therefore, a rapid and accurate method of analysis for these components is desirable for process monitoring. Our studies have found a direct correlation between OH content and bubble formation in S glass-ceramic which has been used to identify critical manufacturing parameters necessary for eliminating bubble formation in the S glass-ceramic during formation of glass-to-metal seals. A lower energy absorption band in S glass-ceramic near 2685 cm^{-1} due to the first overtone of the B-O stretching vibration was used to determine boron concentration. Although the accuracy is slightly lower using FT-ir, it is a much more rapid technique than ion chromatography exclusion for the analysis of boron in S glass-ceramic and thus is more appropriate for measurements on large numbers of samples. 15 refs., 6 figs., 4 tabs.

1034 **Determination of trimethylselenonium ion in urine by ion-exchange chromatography and molecular neutron activation analysis.** Blotcky, A.J.; Hansen, G.T.; Opelanio-Buencamino, L.R.; Rack, E.P. (V.A. Medical Center, Omaha, NE). *Analytical Chemistry;* 57: No. 9, 1937-1941(Aug 1985). Contract FG02-84ER13231.

A method has been developed for the determination of the trimethylselenonium ion (TMSe) in urine by anion exchange-cation exchange chromatography, selectively capturing the TMSe on the cation exchange resin. TMSe recoveries are 91.9 +/- 7.6%. The TMSe fraction is irradiated with neutrons and radioassayed for / sup 77m/Se activity. Various experimental procedures including acid hydrolysis, nitric acid digestion, and HPLC were evaluated in order to optimize the determination. 23 references, 3 figures, 5 tables.

1035 **Element-specific detection of organosilicon compounds by gas chromatography/atmospheric pressure microwave induced helium plasma spectrometry.** Slatkavitz, K.J.; Hoey, L.D.; Uden, P.C.; Barnes, R.M. (Univ. of Massachusetts, Amherst). *Analytical Chemistry;* 57: No. 9, 1846-1853(Aug 1985). Contract AC02-77EV04320.

The gas chromatographic, element-specific detection of organosilicon compounds by atmospheric pressure microwave induced helium plasma spectrometry (GC/MIP) is investigated. At plasma temperatures, silicon is continuously removed from the walls of a quartz discharge tube. This results in a high silicon background response and poor experimental repeatability. Alumina and boron nitride are examined as discharge tubes. Background emission spectra are compared for helium plasmas contained within alumina, boron nitride, and quartz discharge tubes. Silicon detection limits, sensitivity, and selectivity are determined at optimized MIP conditions. A 4.5-pg silicon detection limit is obtained. Simultaneous multielement detection and empirical formula determinations are demonstrated for silicon-, carbon-, hydrogen-, and chlorine-containing compounds. 39 references, 6 figures, 4 tables.

1036 **Preparation of acid standards for and determination of free acid in concentrated plutonium-uranium solutions.** Ryan, J.L.; Bryan, G.H.; Burt, M.C.; Costanzo, D.A. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* 57: No. 7, 1423-1427(Jun 1985). Contract AC05-84OR21400.

Standard nitric acid solutions containing up to 400 g/L plutonium and/or uranium were prepared and these provide a way of rigorously testing methods for the determination of free acid in concentrated plutonium solutions. These standard solutions were prepared from uranyl nitrate hexahydrate and crystalline plutonium(IV) nitrate which was in turn obtained by vacuum evaporation of nitric acid solutions of Pu(IV). Three methods of free acid determination in plutonium solutions were tested, and the widely accepted iodate precipitation methods was shown to give markedly erroneous results at high plutonium concentrations. An improved oxalate complexing procedure was developed which gives accurate results (bias less than the standard deviation of 0.02 M) up to at least 400 g/L plutonium. 27 references, 2 figures, 2 tables.

1037 **Determination of iodine-131 at low concentrations in formaldehyde-preserved milk.** To, K.C.; Rack, E.P. (Kansas Dept. of Health and Environment, Topeka). *Analytical Chemistry;* **57**: No. 7, 1490-1492(Jun 1985).

1038 **Ion microprobe mass spectrometry using sputtering atomization and resonance ionization.** Donohue, D.L.; Christie, W.H.; Goeringer, D.E.; McKown, H.S. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **57**: No. 7, 1193-1197(Jun 1985). Contract AC05-84OR21400.

Resonance ionization mass spectrometry (RIMS) has been applied to the measurement of U and Sm by utilizing ion beam sputtering atomization. The goal is to produce an ultrasensitive analytical technique for measuring elements of environmental concern in small particles or inclusions. An ion microprobe mass analyzer (IMMA) has been modified to allow production of a sputtered atom plume through which high-powered tunable laser radiation is directed. Ions of a given element are produced by a multistep resonance ionization process followed by extraction into a double-focusing mass spectrometer for detection. Data are presented showing mass and optical spectra obtained as well as the sensitivity of the technique. 22 reference, 9 figures, 1 table.

1039 **Differentiating geometric isomers by laser-ion beam photodissociation.** Krailler, R.E.; Russell, D.H. (Texas A & M Univ., College Station). *Analytical Chemistry;* **57**: No. 7, 1211-1216(Jun 1985). Contract AS05-82ER13023.

The laser-ion beam photodissociation reactions of the cis-1,3-pentadiene and trans-1,3-pentadiene $C_5H_8^+$ ions and the cis,trans-2,4-hexadiene and trans,trans-2,4-hexadiene $C_6H_{10}^+$ ions have been investigated. The photodissociation spectra are found to agree qualitatively with the published ion cyclotron resonance (ICR) photodissociation data. Although the $C_5H_8^+$ and $C_6H_{10}^+$ geometric isomers exhibit indistinguishable photodissociation spectra and product ion branching ratios, the wavelength-dependent kinetic energy release values are unique for the individual isomers. The significant changes in the photofragment kinetic energy release values for the trans-1,3-pentadiene and trans,trans-2,4-hexadiene ions as a function of photon energy are attributed to isomerization of the photoexcited parent ion prior to dissociation. 28 references, 5 figures, 2 tables.

1040 **Multiphoton infrared photochemistry for trace gas determination via visible chemiluminescence.** Spurlin, S.R.; Yeung, E.S. (Iowa State Univ., Ames). *Analytical Chemistry;* **57**: No. 7, 1223-1227(Jun 1985). Contract W-7405-ENG-82.

A selective method for determining hydrocarbons in the gas phase is described. Fluorine atoms are produced in a controlled manner from the multiphoton infrared dissociation of SF_6, which is excited by a pulsed CO_2 laser. When C_2 or CH chemiluminescence is monitored, interferences are minimized. The method is useful for sampling at atmospheric pressure at concentrations between 0.2 and 500 ppm. The continuous-flow system allows measurements every 2-3 s. The emission shows a characteristic delay time before reaching its maximum. This suggests a radical chain mechanism in which the excited species are quenched by the various radical species that are produced. 13 references, 7 figures.

1041 **Room-temperature phosphorescence lifetimes and intensities of p-aminobenzoic acid adsorbed on sodium acetate-sodium chloride mixtures.** Senthilnathan, V.P.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Analytical Chemistry;* **57**: No. 7, 1227-1230(Jun 1985). Contract AC02-80ER10624.

Some of the interactions responsible for the room-temperature phosphorescence (RTP) of the p-aminobenzoic acid (PABA) anion adsorbed on sodium acetate-sodium chloride mixtures were elucidated by relative luminescence intensity and phosphorescence lifetime measurements. The luminescence intensity and phosphorescence lifetime values varied over a relatively wide range. The results showed that at least two mechanisms were involved for inducing RTP, with maximum RTP being achieved on pure sodium acetate. Short and long decaying phosphorescent components were detected from the PABA anion. Both of these components reached constant phosphorescence lifetime values even though the phosphorescence intensity continued to change as a function of the composition of phosphorescence-inducing solid-surface material. 16 references, 1 figure, 1 table.

1042 **Atomic line molecular analysis for multicomponent determinations in the gas phase.** Koga, M.; Hadeishi, T.; McLaughlin, R.D. (Univ. of California, Berkeley). *Analytical Chemistry;* **57**: No. 7, 1265-1268(Jun 1985). Contract AC03-76SF00098.

A method to continuously monitor several molecules in the gas phase by measuring absorption in the ultraviolet and vacuum ultraviolet spectral regions is described. This approach is valid even when the spectra overlap. The time required to monitor each species is about equal to the time required to move the monochromator to a new wavelength position. This time will vary depending on the wavelength interval but is approximately 10 s. Molecules characterized by highly structured absorption spectra, diffuse absorption spectra, or mixtures of both can be analyzed. Good agreement between experimental measurements and samples of known concentration was obtained. Special light sources that emit strong atomic and ionic lines in this wavelength region were constructed and are important in achieving high sensitivities. A method of checking for the presence of interferents and improving specificity by using measurements at several wavelengths for one molecule is described. The goal of this work is to apply this technique to on-line process control. 27 references, 3 figures, 4 tables.

1043 **Indirect ion chromatography with radioactive eluents.** Banerjee, S.; Steimers, J.R. (Brookhaven National Lab., Upton, NY). *Analytical Chemistry;* **57**: No. 7, 1476-1477(Jun 1985). Contract AC02-76CH00016.

Indirect detection in liquid chromatography is a method by which an analyte is quantitated by its effect on the composition of the eluent. A property of the eluent responds to the presence of the analyte and is used for quantitation. One such property which has not been used to advantage is radioactivity. If a mixture of nonradioactive anions is chromatographed, then the appearance of each ion from the column will be accompanied by a decrease in radioactivity. To illustrate the method, two systems of chloride ions were equilibrated with a potassium hydrogen phthalate (KHP) buffer doped with Na_2SO_4 [^{35}S]. Injections of sodium chloride were made, and the chloride-containing fractions of the eluate were collected and analyzed off-line by a liquid scintillation counter. 4 references, 1 table.

1044 **Silver particles on stochastic quartz substrates providing tenfold increase in Raman enhancement.** Meier, M.; Wokaun, A.; Vo-Dinh, T. (Swiss Federal Institute of Technology, Zurich). *Journal of Physical Chemistry;* **89**: No. 10, 1843-1846(9 May 1985). Contract AC05-84OR21400.

Exceptionally strong Raman enhancements have been observed for molecules adsorbed on silver deposited onto etched quartz substrates. A stochastic arrangement of tall quartz posts, with an average spacing of ~ 110 nm, is obtained by plasma etching of SiO_2 using a silver island film as an etch mask. Silver particles are produced by angle evaporation. Raman enhancment for adsorbed p-nitrobenzoic acid is maximized by optimizing the deposition parameters, which results in a tenfold enhancement compared to island films and crossed-grating structures. Observation of signals from several polyaromatic molecules demonstrates that the surface provides strong Raman enhancement for a variety of adsorbates. 30 references, 3 figures, 2 tables.

1045 **Separation of helium-methane mixtures by pressure swing adsorption.** Cheng, H.C.; Hill, F.B. (Brookhaven National Lab., Upton, NY). *AIChE (American Institute of Chemical Engineers) Journal;* **31**: No. 1, 95-102(Jan 1985). Contract AC02-76CH00016.

The separation of mixtures of helium and methane using a single column of activated carbon in a pressure swing adsorption process was studied experimentally. Process performance was predicted with an average error of 10% or less by a local-equilibrium well-stirred cell model in which dead volumes at the feed and product ends of the column were accounted for. Systematic differences between experiment and model were ascribed to omission from the model of flow resistance and heat release. 17 references, 8 figures, 1 table.

1046 Variations in the solvent extraction behavior of bifunctional phosphorus-based compounds modified with TBP. Kalina, D.G.; Horwitz, E.P. (Argonne National Lab., IL). *Solvent Extraction and Ion Exchange;* **3**: No. 3, 235-250(1985). Contract W-31-109-ENG-38.

The solvent extraction of americium from nitric acid by several modified bifunctional extractants in CCl_4 has been investigated. For all the compounds examined, addition of a modifier such as tributylphosphate (TBP) enhances distribution ratios at high aqueous acidities. The effect of the modifier at lower acidities varies depending on the basicity of the bifunctional extractant. While the most basic extractants show significantly reduced distribution ratios from lower acid solutions upon TBP addition, for the less basic compounds only slight reductions or, in some cases, even moderate increases in extraction are observed. Studies of the effect of modifier basicity on extraction behavior with modifiers fall within the range of variations observed for diluent effects with extractants of this type. Increases in high acid distribution ratios upon TBP addition to an extractant as simple as trioctylphophine oxide indicate that this modification of extraction behavior may be of general use for a wide range of neutral extractants. 21 references, 3 figures, 1 table.

1047 Method for the detection and differentiation of cellulase components in polyacrylamide gels. Bartley, T.D.; Murphy-Holland, K.; Eveleigh, D.E. (Rutgers Univ., New Brunswick, NJ). *Analytical Biochemistry;* **140**: 1-5(1984). Contract AS05-80ER10702.

Endoglucanase and exoglucanase components of cellulase can be detected and differentiated after polyacrylamide gel electrophoresis by performing activity stains. Endoglucanase activity was visualized in carboxymethyl cellulose agar replicas of gels by staining with Congo red. General β-1,4-glucanase activity was located by soaking the gel in a solution of $NaBH_4$-reduced cellulo-oligosaccharides, and detecting the formation of reducing sugars by reaction with triphenyl tetrazolium chloride. Endoglucanases are active in both assays, while exoglucanases can be distinguished by their activity in the cellulo-oligosaccharide assay only. This methodology has facilitated the purification and characterization of cellulase components from Trichoderma reesei and Microbispora bispora.

1048 Microdetermination of phosphate with cetylpyridinium chloride by constant-current potentiometry. Selig, W.S. (Lawrence Livermore National Lab., CA). *Mikrochimica Acta;* **2**: 133-139(1984). Contract W-7405-ENG-48.

A feasibility study on the potentiometric titration of orthophosphate vs. cetylpyridinium chloride (CPC) by constant-current potentiometry has been reported previously. The procedure involves converting the orthophosphate first to the molybdophosphate, and precipitating it as the tricetylpyridinium 12-molybdophosphate. The optimum conditions were found to be as follows: (1) pH from 1.1 to 1.3, obtained by using 3 ml of 2.5 M hydrochloric acid per 25 ml of solution; (2) a platinum indicator electrode with an applied current of 1.1 μA in the cathodic direction; and (3) a Mo:P ratio of 40 for 1 mg of phosphorus (as orthophosphate). In this report the new phosphate method has been investigated in the range of 8 μg to 8 mg of phosphorus.

1049 In situ identification of paper chromatogram spots by surface enhanced Raman scattering. Tran, C.D. (Brookhaven National Lab., Upton, NY). *Journal of Chromatography;* **292**: 432-438(1984). Contract AC02-76CH00016.

The use of silver hydrosols to enhance the Raman scattering of paper chromatogram spots has been used successfully. This enhancement technique, which is dependent on the interaction between the substrate, silver particles, and paper fibers, has been applied to detection and identification of ng amounts of crystal violet, malachite green, and basic fuchsin with an argon laser of only 4 mW. This technique enhances the resonance of the Raman scattering so that the Raman cross sections of the spots are approximately 9 to 10 orders of magnitude higher than those observed for non-enhanced systems. The limit of detection of the techniques is defined as the amount of dye spot that yields a signal to noise ratio of 2 when excited with the 4MeV.

1050 Simplified model for the coupled transport of metal ions through hollow-fiber supported liquid membranes. Danesi, P.R. (Argonne National Lab., IL). *Journal of Membrane Science;* **20**: 231-248(1984). Contract W-31-109-ENG-38.

This paper describes a simplified model for the carrier-facilitated transport of metal ions through hollow-fiber supported liquid membranes, HFSLM. The model leads to approximate and simple equations describing the concentration variations expected when an aqueous feed solution is flowing through the lumens of a HFSLM module. The equations incorporate simple and independently measurable parameters and apply to two situations: (a) a once-through mode, i.e., the feed solution passes only once through the module, and (b) a recycling mode, i.e., the feed solution is continuously recirculated through the module. The equations have been tested by measuring the transport of Cu^{2+} ions through microporous polypropylene hollow fibers containing a 0.3 F solution of bis (2-ethylhexyl) phosphoric acid in n-dodecane. HFSLM modules containing a variable number of fibers, fibers of different lengths and operated at different linear flow velocities have been used.

1051 Determination of B-C for the (1,0,0) vibrational state of nitrogen dioxide. Hardwick, J.L. (Univ. of Notre Dame, IN). *Journal of Molecular Spectroscopy;* **99**: 239-242(1983).

Although the nu_1 fundamental vibration of NO_2 has been studied at high resolution by infrared spectroscopy, two of the three principal rotational constants have never been determined independently. The reason for this situation is that there are serious intensity anomalies in the vibration-rotation spectrum, and the lines to the red of the band origin are missing. Thus, although the sum of B and C is well determined, their difference (and, consequently, the individual value of each constant) is not. The value of (B - C) for $nu_1 = 1$ has not been determined from the electronic spectrum of NO_2 using the method of dispersed laser-excited fluorescence spectroscopy.

1052 Infrared spectra of the matrix-isolated chlorides of iron, cobalt, and nickel. Green, D.W.; McDermott, D.P.; Bergman, A. (Argonne National Lab., IL). *Journal of Molecular Spectroscopy;* **98**: 111-124(1983).

Iron, cobalt, and nickel metal cathodes were sputtered with various mixtures of $^{37}Cl_2/^{35}Cl_2$/Ar to produce Ar matrices at 14 K that contained the mono-, di-, and trichlorides of the corresponding metal. The measured infrared absorption spectra of these matrices allowed the identification and characterization of $FeCl_2$, $FeCl_3$, CoCl, $CoCl^3$, $CoCl_3$, and $NiCl_2$. The derived vibrational constants of the electronic ground state of $^{59}Co^{35}Cl$ are omega/sub e/ = 457.8 +/- 3.0 cm^{-1} and omega/sub e/chi/sub e/ = 2.0 +/- 1.5 cm^{-1}. The antisymmetric stretching mode frequencies of six isotopomers of $FeCl_2$ and three isotopomers of $CoCl_3$ were identified and measured. The dichlorides of iron, cobalt, and nickel were all determined, in contrast with previous work, to be nonlinear with bond angles of 161, 157, and 161°, respectively. The estimated uncertainty is 5°. For both iron and cobalt trichlorides, the measured stretching mode frequencies were used to derive a Cl-M-Cl angle in excess of 120°, as would be expected for planar molecules with somewhat anharmonic vibrations. Observed adsorption peaks could be assigned to the nu_3(E) modes of planar (D/sub 3h/) Fe and Co trichlorides and the corresponding modes of the isotopomers. These observations strongly suggest that recent data supporting a pyramidal geometry for $FeCl_3$ should be reexamined. The geometry of $CoCl_3$ has not previously been determined. 20 references, 3 figures, 4 tables.

1053 Spectroscopic diagnostics of an argon plasma jet seeded with uranium. Anderson, G.K. (Los Alamos National Lab., NM). pp 333-335 of Analytical spectroscopy. Lyon, W.S. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. ([1985]).

An 80-kW vortex-stabilized plasma torch is used to produce uranium vapor from submicron uranium powder. The torch operates at near atmospheric pressure with a mixture of argon and helium in the ratio of 4:1. The uranium powder is entrained in the Ar:He mixture. The hot gases leaving the torch expand into a

vacuum chamber, forming a supersonic free jet. The arc jet rapidly cools the gases, but also lowers the number density, so that condensation of the metal vapor is prevented. A variety of spectroscopic methods has been used to characterize the plasma torch and the arc jet. Observation of Stark-broadened atomic emission from the torch allows a measurement of both temperature and degree of ionization of the arc gas. Visible emission spectra of the arc jet reveal which chemical species are present. Quantitative determinations of species concentrations in the jet are made by means of absorption spectra. The presence of incompletely vaporized metal powder in the jet is revealed by laser light scattering, and the particle velocities are measured by laser Doppler velocimetry (LDV).

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REFER ALSO TO CITATION(S) 160, 999, 1044, 1052, 1094, 1097, 1098, 1101, 1109, 1112, 1561

1054 **(AECL—8370) Heat capacity data for selected cesium- and iodine-containing electrolytes in water at elevated temperatures.** Saluja, P.P.S.; LeBlanc, J.C. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1985. 40p. AECL, Chalk River, Ontario, Canada $3.00. File Number TI86900119.

Work performed under Canada/US Waste Management Information Exchange Agreement.

The results of heat capacity measurements are presented for cesium halides and cesium iodate in water at 0.6 MPa and in the temperature range 25 to 100°C. Partial molar heat capacity functions, partial molar heat capacity were evaluated by applying Pitzer's ion-interaction model for the extrapolation of calculated apparent molal heat capacity data, phi/sub c/, to infinite dilution. The partial molar heat capacity values in water depend strongly on the cesium salt and the temperature. For all salts, the partial molar heat capacity functions show maxima in the 75 to 93°C range. These data can be used to determine various thermodynamic properties of aqueous cesium and iodine systems at elevated temperatures. 27 refs., 7 figs., 11 tabs.

1055 **(BNL-NCS—36950) Short history on the nomenclature of chemical elements.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-8508138—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001192.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

This paper looks at some aspects in the nomenclature of the chemical elements. A detailed history is available in the book by Weeks (M.E.Weeks, "Discovery of the Elements", Fifth Edition, Journal of Chemical Education, 1945). A review of some of these aspects might help shed light on the present perplexing problem facing the Inorganic Nomenclature Commission, i.e. the problem of trivial names for the heavy elements, whose discovery has been contested by rival groups. Since each of these groups claim primacy, while rejecting the alternative claims of their rivals, is history of any help in solving this dilemna? The following conclusions can be drawn from this discussion. The problem with more than one name for an element is not a new or unique situation. Perhaps it is time to reevaluate the generally accepted solutions. Since new elements are no longer being discovered but are being synthesized, maybe the old formula of allowing the first person to find the element be given the right to name it should be abandoned. It had been suggested previously that a list of names appropriate for elements be drawn up and the Commission could put a number of these in place. Then, when a newly synthesized element is verified, the "new" discoverer would be allowed to contribute a name into the list for some of the future elements. 5 refs.

1056 **(BNL-NCS—36954) Some problems with the 1983 reports on atomic weights and isotopic composition.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-8508138—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001167.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

In this paper, the author discusses the three reports from the Commission published subsequent to the 1983 meeting in Lyngby, Denmark. Some of these comments are in the form of errata to the various reports, while others deal with inconsistencies or perhaps better methods for handling recurring items for future reports. He concludes with some thoughts for consideration by the Commission. It is hoped that discussion of these points will strengthen the Commission's efforts, while easing the burden of the Commission officers when preparing future reports for publication.

1057 **(BNL-NCS—36955) Mononuclidic elements and the 1983 Atomic Mass Table of A.H. Wapstra.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-8508138—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001168.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

During the last Atomic Weight's meetings in Lyngby, Denmark, there was a recommendation from the Subcommittee for the Assessment of Isotopic Composition, (SAIC), for a change in the treatment of uncertainties on atomic weight values from the pair (1,3) to any digit (1,9). This new treatment was adopted and with it a concern about treating the mononuclidic elements in a different manner from the polynuclidic elements. The reason for the difference is due to the fact that one is really accessing uncertainties on the isotopic composition in one case and uncertainties on nuclidic masses in the case of the mononuclidic elements. In the SAIC report on the Element-by Element Review, the present and preferred treatment of data on the mononuclidic elements are examined. For the past dozen years, the following rule has been applied to the nuclidic mass data for these elements. The uncertainty quoted in the atomic mass table is multiplied by a factor of six. If the resulting digit is greater than unity, it is rounded up to one in the preceding digit. The atomic weight is always uncertain to one in the last quoted figure as a result. In 1983, the Commission appointed a working party to review this rule. As a result of a meeting at NBS last year, a new proposal is now being recommended. The factor of six will continue to be used, to account for systematic error (which is not considered in the mass table). However, the rounding up rule will be discontinued and the recommended standard atomic weights will carry uncertainties of from one to nine in the last quoted digit. This paper reviews the new proposed rule and makes some comments on the assumptions made during the discussions at the Lyngby meeting and at the meeting of the working party. 9 refs.

1058 **(BNL-NCS—36958) Comments on the assignment of uncertainties.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 3p. (CONF-8508138—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001187.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

Most experimentalists separate their errors into two distinct categories, random errors and systematic errors. Various statistical methods are available to provide the random error but the experimentalist is usually left with estimating bounds to systematic errors through judgement or experience. A judgement-type estimate of limits to systematic error leads one to wonder if it is merely a guess. There are those who argue that one should never estimate an upper limit to the systematic error but it should be treated as a type of statistical uncertainty. This paper discusses how one should treat this problem as far as atomic weights and isotopic composition are concerned. 8 refs.

1059 **(DOE/ER/13340—1) Heterobimetallic complexes for CO reduction. Annual progress report, March 1, 1985-September 30, 1985.** Stille, J.K. (Colorado State Univ., Fort Collins (USA)). 1 Oct 1985. Contract FG02-85ER13340. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002147.

Goal is to synthesize certain homogeneous heterobimetallic catalysts, containing both an early and a late transition metal, that will reduce carbon monoxide selectively under mild reaction conditions. A Pd dimer containing methyl and one Pd and hydride on the other has been isolated and shown to rapidily insert CO. This

complex eliminates acetaldehyde. Complexes containing combinations of early (Nb, Mo, W) and late (Fe, Co, Rh) transition metals that could be expected to activate carbon monoxide most effectively are primary targets. A complex containing methyls on adjacent Fe and W has been synthesized and the crystal structure determined. An analagous complex containing methyl on Fe and hydride on W exists only as a transient intermediate, generating methane with the formation of a Fe-W bond. The synthesis of dinuclear complexes containing NbH_3 and $Re(CO)_3$ is in progress.

1060 **(DOE/ER/70068—T3) Kinetics of reactions of cyano compounds at high temperatures. Progress report, February 1-September 30, 1985.** Hanson, R.K.; Bowman, C.T. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). 1985. Contract AT03-76ER70068. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000234.

This report summarizes progress during the past 8 months of an ongoing program on the reaction kinetics of cyano compounds at high temperatures. The objectives of this research program are threefold: (1) to obtain high temperature kinetic data on elementary oxidation reactions involving the cyano compounds HCN, CN and NCO; (2) to develop improved procedures for preparing the reactants 0 and 0H in shock tube studies; and (3) to develop improved measurement techniques for the species NCO, CN, NH, OH and H. During this reporting period work has been focussed on the design, assembly and initial testing of an atomic resonance absorption spectroscopy (ARAS) system for monitoring H in shock tube kinetics experiments. 1 fig.

1061 **(DOE/METC—85/4029) Monte Carlo approach to modeling of chemical processes.** Komkov, V. (USDOE Morgantown Energy Technology Center, WV). Jul 1985. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013609.

While the most attractive feature of the Monte Carlo method is the ability to directly simulate diverse physical phenomena (chemical phenomena are regarded as "physics"), it is also a powerful technique for studying differential and integral equations. While considerable activity exists in solving integral equations arising in transport theory, not much recent literature is available on direct applications to solutions of partial differential equations, particularly to systems of nonlinear equations. For a while activity in developing the Monte Carlo method was diminished, but recently there seems to be a revival of stochastic simulation of physical phenomena, particularly in chemistry and material science. 53 refs.

1062 **(DOE/PC/50797—T11) Novel analytical approaches to coal beneficiation. Quarterly report.** Griffiths, P.R. (California Univ., Riverside (USA). Dept. of Chemistry). 1984. Contract FG22-82PC50797. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001313.

A significant fraction of the work performed under this grant in the past year has involved the characterization of adsorbates on catalysts of high surface area by diffuse reflectance (DR) Fourier transform infrared (FT-IR) spectrometry. The heterogeneous reaction of greatest interest in our laboratory is the Fischer-Tropsch synthesis of hydrocarbons from carbon monoxide and hydrogen over supported metal catalysts. Carbon monoxide adsorbed on such catalysts typically absorbs in the region between 2100 and 1800 cm^{-1}. For a catalyst of 0.1% rhodium on alumina, the root-mean-square noise level achieved when two single scan spectra, each measured at a resolution of 4 cm^{-1} in 0.2 seconds, are ratioed is only 0.2% in this wavenumber region. In this report, several spectral measurements of CO and CO/H_2 mixtures adsorbed on supported rhodium will be shown to demonstrate the potential of DR/FT-IR spectrometry for the study of heterogeneous catalysis. 4 refs., 6 figs.

1063 **(IS-T—1124) Single-crystal polarized electronic spectra of the compounds dichlorotetrakis(μ-pivalato)dirhenium(III), tetra-n-butylammonium octachlorodirhenate(III), tetra-n-butylammonium octabromodirhenate(III), dimolybdenum(II) tetrapivalate, and the x-ray diffraction crystal structures of tetra-n-butylammonium octabromodirhenate(III) and two polymorphs of dimolybdenum(II) tetrapivalate.** Huang, H.W. (Ames Lab., IA (USA)). Oct 1985. Contract W-7405-ENG-82. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86002110.

$[N(C_4H_9)_4]_3Re_2Br_8$ crystallizes in the monoclinic space group $P2_1/n$. It has a disordered form, such that 62.1% of the Re-Re bonds are aligned in one direction while 37.9% are aligned in a direction perpendicular to this. For both the octabromo and octachloro salts, highly resolved vibrational structures for the first observed electronic band at about 14,000 cm^{-1} were recorded by the spectrophotometer. It was possible to resolve the Franck-Condon progressions for both the major and minor site components of each compound with intensities consistent with the $\delta \rightarrow \delta^*$ ($^1A/sub\ 1g/ \rightarrow {}^1A/sub\ 2u/$) assignment. However, additional absorption features were observed that have been attributed to further disorder components that have not been revealed by the x-ray diffraction structures. Polarized electronic spectra in the 15,000 to 35,000 cm^{-1} region are reported for $Re_2[O_2CC(CH_3)_3]_4Cl_2$. A peak at 20,200 cm^{-1} is assigned as the electric-dipole-allowed $^1A/sub\ 1g/ \rightarrow {}^1A/sub\ 2u/$ ($\delta \rightarrow \delta^*$) transition with z-polarization. Weak transitions are observed at 21,600, 24,700, 29,000, and 32,000 cm^{-1}. The first three weak transitions appear to be electric-dipole-forbidden vibronically allowed transitions with x, y-polarization. The β- and γ-$Mo_2[O_2CC(CH_3)_3]_4$ form one-dimensional chains along the c-axis of the unit cell. Polarized spectra are reported for these two polymorphs at 300 and 6 K. The evidence available from earlier studies in this research group with $Mo_2(O_2CCH_3)_4$ and $Mo_2(O_2CCF_3)_4$ provides a justification for assigning the lowest energy bands as weak electric-dipole-allowed transitions with molecular z-polarization under the local $D/sub\ 4h/$ symmetry. 65 refs., 26 figs., 17 tabs.

1064 **(IS-T—1172) Synthesis and characterization of new reduced scandium chlorides stabilized by interstitial atoms.** Hwu, S.J. (Ames Lab., IA (USA)). Oct 1985. Contract W-7405-ENG-82. 225p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86002113.

A series of ternary scandium chlorides compounds that contain an interstitial atom in the center of a distorted octahedron of scandium atoms have been synthesized in high yield with high temperature techniques. The compounds characterized by single crystal x-ray diffraction have the stoichiometries $Sc_7Cl_{12}X$, Sc_4Cl_8X, Sc_5Cl_8Y, $Sc_7Cl_{10}C_2$, 1T-Sc_5Cl_7Y, and 3R-Sc_5Cl_7C (X = B or N; Y = C or N). The respective metal arrays in these compounds can be viewed as fragments of scandium metal ranging from discrete Sc_6 cluster species $Sc[Sc_6(X)Cl_8]$, through intermediate single and double infinite chain configurations $Sc_4(X)Cl_8$, $(ScCl_2)[Sc_4(Y)Cl_8]$, and $(ScCl_2)[Sc_5(C)_2Cl_8]$ to double metal close-packed sheets $[Sc_2(Y)Cl_3]$, respectively. The stabilizing effect of scandium-interstitial bond formation was studied. The magnetic susceptibility data of $Sc_7Cl_{12}B$, Sc_5Cl_8C, and $Sc_7Cl_{10}C_2$ reveal interesting but complicated magnetic properties. Another series of scandium monochloride hydrides have also been quantitatively synthesized at high temperatures. The compositions are $ScClH/sub\ x/$ ($0 < x \leqq 1.0$) and $M/sub\ z/ScClH/sub\ x/$ ($M = Li, Na, K$; $0.1 \leqq z < 0.5$; $0.3 \leqq x < 0.9$). Two types of structures have been formed in $ScClH/sub\ x/$, ZrBr-type ($0 < x < 0.67$) and ZrCl-type ($x \geqq 0.67$). The x-ray powder diffraction of intercalated $M/sub\ z/ScClH/sub\ x/$ has shown that the ZrBr-type structure is retained for $z \leqq 0.1$. 94 refs., 26 figs., 21 tabs.

1065 **(IS-T—1175) Reduction of transition metal complexes by tris(bipyridyl)ruthenium(1+) ion, chromium(II) ion, and the 1-hydroxy-1-methylethyl radical.** Connolly, P. II. (Ames Lab., IA (USA)). Oct 1985. Contract W-7405-ENG-82. 157p. NTIS, PC A08/MF A01; GPO Dep. File Number DE86002111.

Thesis.

The kinetics and mechanisms of the reactions of photochemically generated tris(bipyridyl)ruthenium(1+) ion with various metal

complexes were studied. The rates of reduction of some Co(III) complexes near the diffusion controlled limit. Several rare earth ions, Eu^{2+}, Yb^{2+}, and Sm^{2+} were also reacted with the ruthenium(1+) complex. Yb^{2+} was reduced; Sm^{2+} was not reduced. The reductions of some Cr(III) complexes, including pentaaquo(organo)chromium(2+) ions and pentaaquo(pyridine)chromium(3+) ions, were also studied. A rate constant for the reaction between benzylradical and Eu^{2+} is also estimated. The homogeneous catalytic production of H_2 from reduced metal halide solutions (M^{2+} = Cr^{2+}, Eu^{2+}, V^{2+}) is induced by a cobalt(II) macrocyclic complex $Co(dmgBF_2)_2$. A photochemical method for the generation of 1-hydroxy-1-methylethyl radical for kinetic study is presented. This radical is reacted with $BrCo(dmgH)_2$ and $ClCo(dmgH)_2$ to produce the highly colored $Co(dmgH)_2$ complex.

1066 **(LBL—20050) Characterization and catalysis of modified platinum surfaces.** Yeates, R.C. (Lawrence Berkeley Lab., CA (USA)). Jul 1985. Contract AC03-76SF00098. 244p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86001421.

The surface and catalytic properties of single crystal platinum surfaces of (111), (100), (553) and (13,1,1) crystallographic orientations modified by copper, gold and silicon were studied using combined ultra-high vacuum/high pressure techniques. Both gold and copper were found to grow layer-by-layer in (1 x 1) islands on all the surfaces studied. Epitaxial gold and copper simply blocked adsorption sites on the platinum surfaces. Au-Pt and Cu-Pt alloy surfaces generally displayed no order other than a (1 x 1) structure (although a (2 x 2) structure could be obtained on the Cu-Pt(111) and Cu-Pt(100) alloy surfaces with careful annealing. No electronic modification of the platinum in the Au-Pt alloys was observed. Platinum in the Cu-Pt alloys, however, was electronically modified, resulting in a decrease of the CO desorption energy of up to 5 kcal/mol. The n-hexane conversion reaction was used as a model reforming reaction to study the catalytic properties of these alloy surfaces. Surface structure sensitivity of the catalytic behavior was found. In addition to ensemble effects, electronic factors were also important in determining the activity and selectivities of the reaction. Also, mixed gold-platinum sites on the Au-Pt(111) alloy surfaces were found to be more active for the isomerization of n-hexane than pure platinum sites and the mechanism for isomerization at these mixed sites was different than the mechanism at pure platinum sites. The oscillatory behavior of the carbon monoxide oxidation reaction was also studied. The mechanism of the oscillations was different at 10^{-4} torr and 1 atm. When silicon was present on the platinum surface, however, oscillatory behavior in the reaction rate was observed. Oscillations at high pressure were driven by a cyclic oxidation and reduction of the catalyst surface.

1067 **(PNL-SA—13306) Elucidating atomization mechanisms by simultaneous mass spectrometry and atomic absorption spectrometry.** Styris, D.L. (Pacific Northwest Labs., Richland, WA (USA)). Aug 1985. Contract AC06-76RL01830. 25p. (CONF-8509177—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85018527.

From 24. colloquium spectroscopicum internationale; Garmisch-Partenkirchen, F.R. Germany (23 Sep 1985).

Mechanisms responsible for atomization of selenium in graphite furnaces and for stabiiization that occurs when nickel is added to selenium are investigated by mass analyzing, in real-time, the gaseous species from furnaces heated in vacuum and in atmospheric pressure environments. For the latter case, the analysis is done on a molecular beam formed from free-jet expansion of gases from the furnace. The apparatus for doing this is described. Results from the two experimental techniques, when compared, indicate that the primary loss of selenium at low temperatures is from thermal dissociation of selenium dicarbide. Secondary losses are due to vaporization of the dimer and the oxides. Nickel nitrate inhibits formation of the dicarbide, the dimer and the oxides. Mechanisms that are responsible for these findings are postulated. 23 refs., 4 figs.

1068 **Study of structural influence on the formation constants of lanthanide-polyamino polycarboxylate complexes.** Tse, P.K.; Powell, J.E. (Iowa State Univ., Ames). *Inorganic Chemistry;* **24**: No. 18, 2727-2730(28 Aug 1985).

This contribution describes the synthesis of three polyamino polycarboxylic acids (thiobis(ethylenenitrilo)tetraacetic acid, TEDTA; N,N-bis(2-aminoethyl)aniline-N′,N′,N″,N″-tetraacetic acid, BEATA; N,N-bis(2-aminoethyl)ethylamine-N′,N′,N″,N″-tetraacetic acid, DEATA) and reports the stability constant sequences of chelates formed by their anions with the lanthanide elements, as well as the consecutive anion protonation constants (at I = 0.10 and 25°C). The data are compared to corresponding values for a number of analogous polyamino polycarboxylate species derived from tetravalent lanthanons. 32 references, 2 figures, 3 tables.

1069 **Synthetic control of excited states. Nonchromophoric ligand variations in polypyridyl complexes of osmium(II).** Kober, E.M.; Marshall, J.L.; Dressick, W.J.; Sullivan, B.P.; Caspar, J.V.; Meyer, T.J. (Univ. of North Carolina, Chapel Hill). *Inorganic Chemistry;* **24**: No. 18, 2755-2763(28 Aug 1985). Contract AS05-78ER06034.

Two themes are explored with regard to the properties of the metal to ligand charge-transfer (MLCT) excited states of Os(II). For a series of Os(II) complexes it is shown that the MLCT excited states undergo facile oxidative or reductive quenching. Excited-state redox potentials have been estimated by both kinetic quenching and spectroscopic techniques for excited-state oxidative couples and excited-state reductive couples. The second theme, the manipulation of excited-state properties by synthetic changes, follows from a consideration of these factors that dictate excited-state redox potentials. It is shown that in the series $(phen)OsL_4^{2+}$ (L = pyridine, CH_3CN, PR_3, AsR_3, ... and phen = 1,10-phenanthroline) where the metal-ligand basis for the MLCT chromophore remains the same and variations are made in the nonchromophoric ligand, emission energies, excited-state redox potentials, and radiative and nonradiative rate constants all vary systematically with the potential of the ground-state Os(III/II) couple. The results show that it is possible through synthetic changes to control excited-state properties in a systematical way. 37 references, 6 figures, 5 tables.

1070 **(UCRL-Trans—12071) Ternary fluorides of gallium and strontium.** Julien, P.; Chassaing, J. (Lawrence Livermore National Lab., CA (USA)). 30 Jul 1985. Contract W-7405-ENG-48. Translation of C.R. Acad. Sc. Paris, Volume 271 (15 July 1970). 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85017109.

The liquid-solid equilibrium diagram for the GaF_3-SrF_2 system indicates two tetragonal, iso-type compounds: $SrGaF_5$: a = 14.32 A, c = 7.28 A, with 16 molecules per unit cell, with congruent melting, F 812°C, and $Sr_5Ga_8F_{19}$: a = 14.22 A, c = 7.27 A with 4 molecules per unit cell. $SrCaF_5$ forms a continuous solid solution with $PbGaF_5$, the same as $Sr_5Ga_8G_{19}$ with $Pb_2(GaF_5)_2$. 7 refs., 1 fig., 2 tabs.

1071 **X-ray photoelectron spectra and bonding in transition-metal phosphides.** Myers, C.E.; Franzen, H.F.; Anderegg, J.W. (Iowa State Univ., Ames). *Inorganic Chemistry;* **24**: No. 12, 1822-1824(5 Jun 1985). Contract AC02-78ER04948.

X-ray photoelectron spectra of solid ScP, TiP, VP, MnP, and FeP have been obtained in the valence-conduction band region and for the 2p/sub 3/2/ core levels of both metal and phosphorus. The results show a regular increase in photoelectron intensity near the Fermi energy and a regular decrease in core level shifts relative to the elements across the series. These are interpreted as arising from a decreasing ionicity coupled with increasing metallic character accompanying the increasing number of metal d electrons.

1072 **Extended measurement and assignment of isotropic Raman transitions in the νY region of $^{12}CD_4$.** Lolck, J.-E. (Aarhus Univ. (Denmark). Dept. of Chemistry); Owyoung, A.; Esherick, P. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Raman Spectroscopy;* **16**: No. 3, 163-170(Jun 1985).

The isotropic Raman spectrum of $^{12}CD_4$ is presented in the range from 2101 to 2113 cm^{-1}, thus covering the $\nu_1(A_1)$ Q-branch and part of the $\nu_2 + \nu_4(F_1 + F_2)$ Q-branch. Experimental results for the 2101 to 2108 cm^{-1} range were obtained using the 'inverse Raman spectroscopy' technique and have been published previous-

ly. New measurements in the 2108 cm^{-1} to 2113 cm^{-1} range were obtained using the very similar 'stimulated Raman gain spectroscopy' technique. In both spectra the resolution is limited by the Doppler width of the lines. Formally, only transitions to the upper state of the ν_1 band are allowed in isotropic Raman scattering, but strong resonances enhance transitions to the upper state of $\nu_2 + \nu_4$. An effective Hamiltonian which takes these resonances into account was used to interpret the spectra and led to the assignment of all significant lines. In all, 165 Raman transitions were assigned, and these transitions are fitted by the model Hamiltonian with a standard deviation of 0.008 cm^{-1}.

1073 **Quantum mechanical rate constants via path integrals: diffusion of hydrogen atoms on a W(100) surface.** Jaquet, R.; Miller, W.H. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **89**: No. 11, 2139-2144(23 May 1985). Contract AC03-76SF00098.

Using Monte Carlo path integrals methods quantum mechanical rate constants have been calculated for diffusion of H atoms on a model W(100) surface. The most interesting aspect of the present work is that it includes the effect of surface atom motion, i.e., phonons, on the H atom tunneling dynamics. Although the description is fully quantum mechanical, the phonons enter the present path integral treatment in a way very similar to how they appear in the classical generalized Langevin models; the present formulation thus provides the correct quantum mechanical analogue to classical frictional effects. The principal qualitative results shown by the calculations is that surface atom motion increases the rate of H-atom tunneling from one stable site on the surface to another. 23 references, 3 figures, 2 tables.

1074 **Theoretical thermochemistry. 1. Heats of formation of neutral AH/sub n/ molecules (A = Li to Cl).** Pople, J.A.; Luke, B.T.; Frisch, M.J.; Binkley, J.S. (Carnegie-Mellon Univ., Pittsburgh, PA). *Journal of Physical Chemistry;* **89**: No. 11, 2198-2203(23 May 1985).

Ab initio molecular orbital theory (Moller-Plesset theory to full fourth order and a series of extended basis sets) is used to compute total atomization energies for the complete series of AH/sub n/ hydrides (A = Li to Cl). These data are used in combination with generally accepted experimental data on isolated atoms to predict ideal gas heats of formation at 298.15 K for these molecules. Comparisons with high-quality experimental data indicates that, for hydrides, this level of theory has an error level of about +/-2 kcal mol^{-1}. For several of these hydrides, there are no experimentally determined heats of formation. The authors predict $\Delta H/sub\ f/^{\circ}_{298}$ values (in kcal mol^{-1}) for BeH_2 (39.5), MgH_2 (38.6), AlH_3 (64.0), PH (59.2), and PH_3 (34.8). The authors computed heats of formation call into question the experimental heats of formation of BH_3 and SiH_2. 23 references, 4 tables.

1075 **Generalized transition state theory and least-action tunneling calculations for the reaction rates of H(D) + H_2(n=1) → H_2(HD) + H.** Garrett, B.C.; Truhlar, D.G. (Chemical Dynamics Corp., Columbus, OH). *Journal of Physical Chemistry;* **89**: No. 11, 2204-2208(23 May 1985). Contract AC02-79ER10425.

Improved canonical variational theory calculations are reported with least-action transmission coefficients for the reactions H + H_2(n=1) and D + H_2(n=1), where n denotes the vibrational quantum number, in both collinear and three-dimensional worlds and for three different potential surfaces. Where possible comparisons to accurate or more complete quantal calculations are made and very good agreement is found. For the three-dimensional reaction and the most accurate available potential energy surfaces comparisons to all available experimental determinations at 297-356 K are made; the experimental results are larger than the calculated rate constants by factors of (in chronological order) 26, 17, 60, 5, and 8. The disagreement is probably due in large part to the difficulty of experiments. 50 references, 1 figures, 7 tables.

1076 **Intraatomic correlation correction in the FORS model.** Lam, B.; Schmidt, M.W.; Ruedenberg, K. (Ames Lab., IA). *Journal of Physical Chemistry;* **89**: No. 11, 2221-2235(23 May 1985).

Wave functions in the full optimized reaction space (FORS) can be expressed in terms of localized configuration-generating MO's which have essentially atomic character. It is therefore possible to construct from them deformed atomic configuration state functions and from these, in turn, antisymmetrized products of deformed atomic state functions. These composite functions (CF's) form an alternate basis for the full reaction space, and they can be considered as the optimal intrinsic basis for implementation of the deformed-atoms-in-molecules approach of Moffitt, Hurley, and Arai. The FORS composite functions have the further advantage of forming an orthonormal set, a circumstance which simplifies introduction of the intraatomic correlation corrections conceptually as well as operationally, since there is no need for additional assumptions to compensate for the nonorthogonality of the composite functions. The mathematical formalism for a general application of this method and, in particular, the operational specifics of the transformation from molecular antisymmetrized orbital products to composite functions of atomic states are explicitly developed. Tables facilitating this transformation are given for all atomic valence states arising from the configuration s/sup n/p/sup m/. An application to the ground-state of NH is presented. 47 references, 1 figure, 7 tables.

1077 **Effect of solution microstructure on the hydrated electron absorption spectrum.** Kreitus, I.V. (Latvian State Univ., Riga, USSR). *Journal of Physical Chemistry;* **89**: No. 10, 1987-1990(9 May 1985).

The changes in the optical characteristics of pulse radiolytically generated electrons have been measured in LiCl solutions in H_2O and D_2O at 21 °C over the range 0-15 M. Increasing the LiCl concentration causes a nonuniform increase of the energy of the e/sub aq/$^-$ absorption spectrum maximum and the half-width of the absorption band. More rapid changes in concentration regions corresponding to LiCl. $6H_2O$ and LiCl. $4H_2O$ are related to solution microstructure. The shift of the e/sub aq/$^-$ absorption spectrum is compared with the experimentally measured displacement of the e/sub aq/$^-$ conduction band. The latter, as well as changes of the electron hydration energy, is found to be responsible for the observed differences in the e/sub aq/$^-$ absorption band with increasing LiCl concentration. Spectral characteristics are analyzed from the positions of trap-trap and continuum concepts of optical excitation and from cavity and hydrated H_2O^- electron models. 29 references, 4 figures.

1078 **Interdendritic spacing: Pt. II. A comparison of theory and experiment.** Trivedi, R. (Ames Laboratory-USDOE, Ames, IA). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 6, 977-982(Jun 1984).

The primary spacing data of Part I are compared to the existing theoretical models of Hunt and of Kurz and Fisher, and a significant disagreement is found. A theoretical model based on the Hunt model is developed, and it is found that the theory adequately explains the variation in primary spacing, λ_1 corresponds to the growth rate, V. A maximum in λ_1 vs V is predicted and the velocity at which the maximum occurs matches with the result obtained experimentally. It is shown that the maximum in λ_1 corresponds to the dendrite-to-cell transition and cellular structures are found to grow with much smaller spacings than dendritic structures under identical growth conditions.

1079 **Direct synthesis of sodium polysulfides from sodium and sulfur.** Brown, A.P.; Battles, J.E. (Argonne National Lab., IL). *Synthesis and Reactivity in Inorganic and Metal-Organic Chemistry;* **14**: No. 7, 945-951(1984).

A method is described for synthesizing sodium polysulfides of stoichiometries Na_2S_3, Na_2S_4, and Na_2S_5 by the direct reaction of sodium and sulfur. The reaction is carried out in the furnace well of an inert-atmosphere glove box and features the slow addition of sulfur to molten sodium at temperatures ranging from 100-150°C at the start of the reaction to about 300°C at the end. Batches of 150-200 g of polysulfide product can be prepared with yields approaching 100% and a high purity. 16 references, 1 table.

1080 **Isothermal flow calorimeter designed for high temperature, high pressure operation.** Christensen, J.J.; Izatt, R.M. (Brigham Young Univ. Provo, UT). *Thermochimica Acta;* 73: 117-129(1984). Contract AC02-82ER13024.

An isothermal flow calorimeter suitable for measuring either endothermic or exothermic heats of mixing from 373 to 673 K and from 0.1 to 40.5 MPa is described. An automatically controlled pulsed heater and a highly stable heat leak path are used to maintain the reaction zone at a constant temperature. Energy effects from 0.15 to 120 J min^{-1} can be measured to an accuracy of +/- 0.8% at a constant temperature and pressure. The calorimeter was tested by measuring the heat of mixing of water-ethanol at 413 K and 1 MPa and was found to produce data in good agreement with previously measured values. 21 references, 4 figures, 3 tables.

1081 **Intramolecular dynamics of highly excited carbonyl sulfide (OCS).** Davis, M.J.; Wagner, A.F. (Argonne National Lab., IL). *ACS Symposium Series;* No. 263, 337-349(1984). Contract W-31-109-ENG-38.

The intramolecular dynamics of highly excited OCS has been studied within the framework of classical mechanics. One study involves the energy relaxation of OCS restricted to planar geometry. A second study investigates the unimolecular dissociation of OCS. It has been found that the relaxation of OCS is slow and appears to occur on two time scales. In addition, the relaxation still persists at 45 ps. Reasons for such an effect, as well as diagnostic techniques, are discussed. Since the causes for such effects persist above dissociation they lead to nonstatistical unimolecular dissociation, which also shows a high degree of mode specificity.

1082 **Pressure-density relationships and ionization equilibria in aqueous solutions.** Marshall, W.L.; Mesmer, R.E. (Oak Ridge National Lab., TN). *Journal of Solution Chemistry;* 13: No. 6, 383-391(1984). Contract W-7405-ENG-26.

Adjustment of a constant in the pressurization terms of the El'yanov-Hamann equation for the pressure dependence of the logarithm of ionization constants of solutes gives a close approximation to log density of the solvent over a limited range of temperature and density. (That is, it gives an equation of state for the solvent.) The density relationship, however, is more universally applicable to the description and prediction of ionization equilibria.

1083 **Intercalation of graphite by silicon tetrafluoride and fluorine to yield a second-stage salt $C_{24}SiF_5$.** Rosenthal, G.L.; Mallouk, T.E.; Bartlett, N. (Univ. of California, Berkeley). *Synthetic Metals;* 9: 433-440(1984). Contract AC03-76SF00098.

Powdered graphite (either finely broken HOPG or Union Carbide SP1) interacts with 1:1 SiF_4F_2 mixture (~ 50 atmospheres) at 40°, to yield a second-stage compound (a_0 = 2.46(1), c_0 = 11.29(1) A) of composition C~ $_{24}SiF_5$. This product interacts with excess PF_5 with quantitative displacement of SiF_4 to yield a first-stage fluorophosphate (a_0 = 2.46(1); c_0 = 7.65(1) A). The first-stage fluorophosphate falls to a second-stage salt (a_0 =2.46(1); c_0 = 10.87 A) under vacuum. This is identical to that prepared directly by the reaction of PF_5 and F_2. Extensive reduction of $C_{24}PF_{66}$ at ~ 20° to graphite of crystallinity comparable to that of the starting graphite established that the initial $C_{24}SiF_5$ does not involve extensive fluorination of the graphite. The ease of displacement of SiF_4 by superior fluoroacids indicates that $C_{24}SiF_5$ can be a valuable precursor for other graphite salts. Ready formation of a first-stage fluoroborate, C_7BF_4, I/sub c/ = 7.70(1) A contrasts with the failure to prepare similarly a first-stage SiF_5^- salt.

1084 **Comparison of the carbon-13 hyperfine constants of carboxylated cyclohexadienyl and hydroxycyclohexadienyl radicals.** Sangster, R.N.; Madden, K.P.; Schuler, R.H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* 87: No. 13, 2395-2398(1983).

^{13}C ESR spectra of the H atom adducts to pyromellitic and benzenepentacarboxylic acids have been observed. Comparison of the ^{13}C hyperfine constants with those previously obtained for the OH adducts shows essentially identical values at the carboxyl positions and significant differences for the ring atoms only at the C_a and C_e positions. The spin density distribution in the π system is clearly not affected to any significant extent by OH substitution. In spite of this the ^{13}C hyperfine coupling constants for C_a, the site of addition, are 13 and 23% lower, respectively, in the OH adducts. This finding is at variance with correlation of ^{13}C couplings strictly in terms of the local and adjacent π spin densities. Since there is no appreciable loss of spin density from the π system the effects of OH substitution cannot arise directly from transfer of spin density to the C_a position. Rather these effects must result from changes in the interactions between the σ and π systems introduced by the substitution. It is suggested that the differences noted here, and the related drop of ~ 35% in the proton hyperfine constants at C_a, result mainly from the loss of symmetry in the OH substituted radicals. 12 references, 1 figure, 1 table.

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REFER ALSO TO CITATION(S) 11, 38, 136, 260, 1014, 1062, 1063, 1068, 1069, 1076, 1082, 1126, 1133, 1146, 1149

1085 (BNL—51847, pp 1-10) **Characteristics of synchrotron radiation.** Thomlinson, W. (Brookhaven National Lab., Upton, NY). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

This introductory paper gives a brief, condensed summary of the properties of synchrotron radiation (SR), which have brought it to the fore as a research tool. The National Synchrotron Light Source at Brookhaven National Laboratory is used for illustrative purposes. The properties of the radiation emitted from the storage ring dipole bending magnets are considered in some detail. Certain insertion devices, which can be inserted into the straight sections of storage rings and which are more effective than the bending magnets at producing radiation are discussed. These are called wigglers and undulators and illustrate the direction being taken in the development of new, high brightness sources. Presently operating synchrotron radiation facilities in the US are tabulated.

1086 (BNL—51847, pp 123-125) **Selective chemistry with synchrotron radiation.** Hanson, D.M. (State Univ. of New York, Stony Brook). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Excitation of deep valence and core electrons associated with the common elements in molecules of chemical and biological interest is possible with the energy from synchrotron light sources. Since the differences in binding energies are tens of hundreds of electron volts, it is possible to excite the 1s, 2s, or 2p electrons of C, N, O, F, Si, P, S, or Cl by using monochromatic radiation. The possibility also exists of selectively exciting different atoms of the same element that are found in different chemical environments of the molecule. Photon stimulated ion desorption from thin polymer films has already been studied. Selective chemistry following selective core level excitation has been shown to occur in the gas phase, e.g., for acetone the 2p*1s excitation at 289eV results almost exclusively in C^+ and O^+ ions, whereas excitation of the alkyl carbon 1s electrons at higher energies produces other ions. It is also possible to determine whether the chemistry of a compound is group selective or bond selective.

1087 (BNL—51847, pp 126-132) **SUNY small-angle x-ray diffractometer.** Chu, B.; Phillips, J.; Wu, D.Q. (State Univ. of New York at Stony Brook, Long Island). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The relation between small-angle x-ray scattering, small-neutron scattering, and light scattering spectroscopy is described. The basic design of a small-angle x-ray diffractometer is presented.

1088 (BNL—51847, pp 161-164) **Linear, position-sensitive x-ray detector used for real-time calculations of small-angle scattering parameters with submillisecond resolution.** Borso, C.S. (Argonne National Lab., IL). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—). Contract W-31-109-ENG-38.

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

A fast detector system optimized for measurements of fluctuations in small-angle scattering parameter is described in detail. The basic component of the detector is an RL1024S photodiode array packaged in a standard dual in-line IC configuration that is mounted on a copper cold finger to permit cooling. The detector has been tested at Stanford Synchrotron Radiation Laboratory, and the results of various biological experiments have been monitored. The results have verified the feasibility of the design, and such a system should be useful for studying perturbations in scattering characteristics induced by a wide variety of controllable parameters, e.g., electric and magnetic field variations, pH, ionic strength, enzyme reactions, and disturbances required for stress analysis.

1089 (BNL—51847, pp 165-172) **Scattering from correlations in colloidal systems.** Hayter, J.B. (Oak Ridge National Lab., TN). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—). Contract AC05-84OR21400.

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Some static light and small-angle neutron scattering (SANS) results on colloidial suspensions, both at equilibrium and in steady-state non-equilibrium situations, are reviewed. Some dynamic measurements on polymer solutions and melts made using the neutron spin-echo (NSE) technique are discussed. Emphasis is paced on experiments which have a possible counterpart in synchrotron radiation studies. Discussion is restricted to suspensions in which the particles interact with one another.

1090 (BNL—51847, pp 173-178) **Structure of microemulsions by SANS.** Huang, J.S. (Exxon Research and Engineering Co., Annandale, NJ). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Small-angle neutron scattering (SANS) has been used to determine the structure of microemulsions in the system hydrocarbon-water-sodium di-ethylhexylsulfosuccinate (AOT). SANS spectra taken in a deuterated solvent showed a perfect Guinier fit with a radius of gyration of 15A regardless of the amount of AOT from 0.1 to 5% present. By varying the proportions of deuterated and undeuterated solvent to vary the contrast between the micelles and the solvent, it is concluded that the micelles are basically monodispersed spherical aggregations of 22 AOT molecules.

1091 (BNL—51847, pp 179-187) **SANS studies of polymers.** Wignall, G.D. (Oak Ridge National Lab., TN). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—). Contract AC05-84OR21400.

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Some information provided by the application of small-angle neutron scattering concerning polymer structure is reviewed herein. Information about the polymer structure as examined in H_2O/D_2O mixtures is also provided. Examples of results of experiments performed at the National Center for Small-Angle Scattering Research are included.

1092 **(CONF-850871—13) Exotic organic superconductors based on BEDT-TTF and the prospects of raising T/sub c/'s.** Williams, J.M.; Beno, M.A.; Wang, H.H.; Geiser, U.W.; Emge, T.J.; Leung, P.C.W.; Crabtree, G.W.; Carlson, K.D.; Azevedo, L.J.; Venturini, E.L. (Argonne National Lab., IL (USA); Sandia National Labs., Albuquerque, NM (USA); North Carolina State Univ., Raleigh (USA)). 1985. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018407.

From International conference on neutron scattering; Santa Fe, NM, USA (19 Aug 1985).

Ambient-pressure superconductivity has now been discovered in five systems based on BEDT-TTF:X, X^- = polyatomic monovalent-anion. The highest T/sub c/ reported is 5 K, in $(BEDT\text{-}TTF)_2AuI_2$, and it appears that much higher T/sub c/'s are possible if disorder (molecular and anionic), and structural modulation, can be avoided in new derivatives containing monovalent triatomic anions. 28 refs., 4 figs.

1093 **(DOE/ER/10722—1) Laser photoelectron spectroscopy of ions. Progress report, February 1, 1985-January 31, 1986.** Ellison, G.B. (Colorado Univ., Boulder (USA)). Oct 1985. Contract AC02-80ER10722. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001631.

During the last 13 months we have completed several spectroscopic studies and begun work on the design and construction of a new generation photoelectron spectrometer. A review article on radical ions was written. This review was solicited for a special Symposium in Print on the "Structure and Reactivity of Organic Radical Ions" in the journal Tetrahedron. Over the summer in 1984 we were able to take beutiful electron spectra of S^-_3 and S_2O^-. It made more sense to include them with in a single paper with the related ion, SO^-_2 rather than having several disjoint communications. Consequently we entirely re-wrote our earlier SO^-_2 paper so as to compare and contrast this family of ions. 18 refs., 3 figs.

1094 **(DOE/PC/60804—T8) Thermophysical properties correlations and pseudocomponent characterization parameter estimation for fossil fluids. Second annual report, September 1, 1984-August 31, 1985.** Starling, K.E.; Lee, L.L.; Ellington, R.T.; Watanasiri, S.; Khan, M.A.; Langenberg, M.A.; Mannan, M.; Sheth, K. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 1985. Contract FG22-83PC60804. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000197.

This report summarizes work performed during the period September 1, 1984 through August 31, 1985. During this period, the companion correlations for dilute-gas viscosity and thermal conductivity have been developed. Both correlations are applicable to nonpolar, polar and associating fluids. The correlations require four characterization parameters as input, namely, critical temperature, critical volume, acentric factor, and dipole moment. One important feature of these correlations is that none of the characterization parameters has to be regressed from experimental viscosity or thermal conductivity data. This feature allows for apriori prediction of dilute gas viscosity and thermal conductivity. The correlation for dilute gas viscosity eta_0 uses the Chapman-Enskog expression. The main departure from other earlier work on eta_0 includes the use of the Stockmayer potential for polar and associating compounds. The dipole moment, along with molecular weight, critical temperature, critical volume and accentric factor, was found to be adequate in characterizing both polar and associating fluids studied in this work. A total of 757 data points were used covering 14 nonpolar, 11 polar, and 7 associative fluids. The overall deviation is 1.37%. A detailed description of the correlation is given in Appendix A. The correlation for dilute gas thermal conductivity presented uses a modified Mason-Monchick expression. It uses the same characterization parameters as those for the viscosity correlation. A total of 1136 data points were used in testing the correlation. The overall deviation is 5.44%. A detailed description of the correlation is given in Appendix B.

1095 **(LA-UR—85-3180) Synthesis of ^{13}C-enriched carbohydrates as chiral synthons for labeled compounds.** Walker, T.E.; Unkefer, C.J.; Ehler, D.S. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 3p. (CONF-8509173—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000780.

From 2. international symposium on the synthesis and application of isotopically labeled compounds; Kansas City, MO, USA (3 Sep 1985).

Methods have been developed to synthesize labeled chiral compounds from labeled carbohydrates. During the course of these investigations, we have adapted both chemical and enzymatic methods for the large-scale interconversion of labeled aldoses and ketoses. 6 refs.

1096 **Proton-ionizable crown compounds. 1. Synthesis, complexation properties, and structural studies of macrocyclic polyether-diester ligands containing a triazole subcyclic unit.** Bradshaw, J.S.; Chamberlin, D.A.; Harrison, P.E.; Wilson, B.E.; Arena, G.; Dalley, N.K.; Lamb, J.D.; Izatt, R.M.; Morin, F.G.; Grant, D.M. (Brigham Young Univ., Provo, UT). *Journal of Organic Chemistry;* **50**: No. 17, 3065-3069(23 Aug 1985). Contract AC02-78ER05006.

A series of macrocyclic polyether-diester ligands containing a proton-ionizable triazole subcyclic unit has been prepared. The crystal structure of one ligand shows that it forms a hydrate with the water molecule located in the macrocyclic cavity. The water is coordinated by hydrogen bonding to two oxygen atoms of the macrocycle and to the NH group of the triazole moiety. These macrocycles also form complexes with amines. These amine complexes are kinetically more stable than complexes formed by the triazole ligands with the corresponding alkylammonium perchlorate salts. The crystal structure of one of these complexes shows that the triazole ring has donated a proton to the amine group. 41 references, 4 figures, 2 tables.

1097 **X-ray photoelectron spectroscopic study of trifluoromethyl isocyanide. Back-bonding, fluorine lone-pair ionization potentials, and the $CF_3NC \rightarrow CF_3CN$ isomerization energy.** Beach, D.B.; Jolly, W.L.; Lentz, D. (Lawrence Berkeley Lab., CA). *Inorganic Chemistry;* **24**: No. 12, 1892-1894(5 Jun 1985). Contract AC03-76SF00098.

Core binding energy data for CF_3NC, $Cr(CO)_5CNCF_3$, and $W(CO)_5CNCF_3$ indicate that CF_3NC is a very strong π-acceptor ligand, practically as strong as CO. The core and fluorine lone-pair valence ionization potentials of CF_3NC and CF_3CN show that the net interaction of the fluorine lone-pair orbitals with other orbitals in these molecules is zero. The core data for CF_3NC and CF_3CN, when interpreted with the equivalent cores approximation, lead to a $CF_3NC \rightarrow CF_3CN$ isomerization energy of -23 kcal mol^{-1}.

1098 **Theoretical study of the structure and spectroscopic characteristics of protonated carbon dioxide.** Frisch, M.J.; Schaefer, H.F. III; Binkley, J.S. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **89**: No. 11, 2192-2194(23 May 1985).

Protonated carbon dioxide has been examined theoretically by using geometries optimized at the MP2/6-31G(d) level and energies computed at the MP4/6-311++G(d,p) level. It is concluded that the C/sub s/ O-protonated complex is the only observable form of CO_2H^+ when it is produced by association of H^+ with CO_2 and under most other conditions. The enthalpy of protonation of CO_2 is found to be 130.7 kcal mol^{-1} at 298 K. Rotational constants are predicted to be 773.74, 10.79, and 10.65 GHz for CO_2H^+ and 431.18, 10.17, and 9.94 GHz for CO_2D^+. Stretching vibrational frequencies are predicted to be 1292, 2330, and 3348 cm^{-1} for CO_2H^+ and 1270, 2316, and 2485 cm^{-1} for CO_2D^+. The O-H (or O-D) stretching mode is expected to produce the most intense fundamental transition in both the infrared and Raman spectra, and the 2330 (2316)cm^{-1} C-O stretch is found to be the only other intense mode. 23 references, 3 tables.

1099 **Redox vs. Lewis acid catalysis. The chemistry of 1,2-diarylethanes in $SbCl_5$-rich molten salt media.** Buchanan, A.C. III; Chapman, D.M.; Smith, G.P. (Oak Ridge National Lab., TN). *Journal of Organic Chemistry;* **50**: No. 10, 1702-1711(17 May 1985). Contract AC05-84OR21400.

The product selectivity for the reactions of 1,2-diarylethanes, $ArCH_2CH_2Ar$ [Ar = phenyl (DPE), 1-naphthyl (DNE), and 9-anthryl (DAE), in $SbCL_5$-rich molten salt media at 80-150°C is found to be highly dependent on the nature of the aryl group. This chemistry, which has been examined primarily by in situ ^1H NMR and by quench and separation techniques, is interpreted in terms of a change in mechanism from Lewis acid catalysis to redox catalysis as the aryl group becomes more oxidizable. DPE is activated solely by the Lewis acid function of the melt, which generates a benzylic carbenium ion, ArC^+HCH_2Ar, as a reactive intermediate by hydride abstraction by $SbCl_5^+ \times nSbCl_5$. This intermediate leads to transalkylation products resulting from the selective cleavage of the benzylic (sp^3-sp^3) carbon-carbon bond. DAE, on the other hand, is activated by the redox function of the melt, which generates a radical cation intermediate, $ArCH_2CH_2Ar^+$, by oxidation by Sb^{3+}. At 80 °C, the primary reaction pathway for the DAE radial cation is an intramolecular aryl-aryl coupling with internal hydrogen transfer to produce an unusual spiro isomer of DAE in high yield. At higher temperatures (150°C) cleavage of the ethylenic (sp^3-sp^3) carbon-carbon bond in the radical cation becomes an important process in competition with the intramolecular coupling. For DNE, combined Lewis acid catalysis (positional isomerization and transalkylation) and redox catalysis (intramolecular coupling) generates a complex product mixture. The reactions observed for DAE^+ and DNE^+ in these highly purified anhydrous $SbCl_5$-rich melts are discussed in relation to reaction pathways for alkylbenzene and diarylethane radical cations in other media. 54 references, 1 figure.

1100 **Critical point and phase separation for an ionic system.** Pitzer, K.S.; de Lima, M.C.P.; Schreiber, D.R. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **89**: No. 10, 1854-1855(9 May 1985). Contract AC03-76SF00098.

Liquid-liquid phase separation and a critical point have been observed for a system involving a fused salt. Specifically the system is tetra-n-butylammonium picrate-1 -chloroheptane for which T/sub c/ = 414.4 K, chi/sub c/ = 0.08$_8$ mole fraction picrate, and V/sub c/ = 2300 $cm^3 \times mol^{-1}$ picrate. The critical mole fraction of picrate is very small, and the phase diagram is very asymmetric. The critical exponent shows the mean field value of 0.50 with no detectable departure near the critical point, although the present experiments were not designed for a very precise test of the last topic. 5 references, 2 figures, 1 table.

1101 **Bolometric evidence for cluster formation in supersonic molecular beams of CO_2 and C_4F_8.** Spector, G.B.; Brady, B.B.; Flynn, G.W. (Columbia Univ., New York, NY). *Journal of Physical Chemistry;* **89**: No. 10, 1875-1879(9 May 1985). Contract AC02-78ER04940.

A bolometer/mass spectrometer/flux meter technique was used to study the effect of cluster formation on adsorption energy in molecular beams of CO_2 and C_4F_8. In beams of CO_2, which are known to contain large clusters at high backing pressures, the experimentally measured adsorption energy per molecule drops effectively to zero at backing pressures above 50 psi, in agreement with a simple model for adsorption energy at various cluster sizes. In C_4F_8, the beam is heavily clustered at all backing pressures and the apparent adsorption energy is found to decrease significantly. 38 references, 7 figures.

1102 **Radiolytic studies of the redox reactions and alkylation of rhodium tetrakis(4-sulfonatophenyl)porphyrin in aqueous solutions.** Baral, S.; Hambright, P.; Harriman, A.; Neta, P. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **89**: No. 10, 2037-2042(9 May 1985).

Reduction of the stable Rh/sup III/TPPS (tetrakis(4-sulfonatophenyl)porphyrin) by radiolytic, chemical, or photochemical methods in alkaline aqueous solution results in the formation of Rh/sup II/TPPS which dimerizes to (Rh/sup II/TPPS)$_2$ bridged by a Rh-Rh bond. This species is stable toward further reduction in most cases, but pulse radiolysis studies have shown that it can be reduced to the π-radical anion by the solvated electron. In neutral or acidic solution Rh/sup II/TPPS forms a hydride HRh/sup III/TPPS rather than a dimer although there is some competitive formation of a chlorin. Addition of acid to (Rh/sup II/TPPS)$_2$ results in the formation of Rh/sup III/TPPS and HRh/sup III/TPPS while addition of alkali to the hydride results in formation of (Rh/sup II/TPPS)$_2$. Alkyl adducts, R-Rh/sup III/TPPS, analogous to the hydride, are formed upon reduction of Rh/sup III/TPPS in the presence of alkyl chlorides. 30 references, 6 figures.

1103 **Effect of micellar interface modifications on the reactivity of embedded photoproduced cations.** Plonka, A.; Kevan, L. (Univ. of Houston, TX). *Journal of Physical Chemistry;* **89**: No. 10, 2087-2089(9 May 1985). Contract AS05-80ER10745.

Lifetime distributions of photoproduced N,N,N',N',-tetramethylbenzidine cation radicals (TMB^+) in micellar solutions of dodecyltrimethylammonium chloride (DTAC) and sodium dodecyl

sulfate (SDS), with and without NaCl or 1-butanol added to modify the micellar interface potential, were determined for inverse Laplace transforms of the decay curves adequately approximated by $[TMB^+]/[TMB^+]_0 = \exp[-(t/tau_0)]/sup\ \alpha/$. The constant α, determining the width of the TMB^+ lifetime distribution, was found to be insensitive to these micellar interface modifications, while the variation of the effective lifetime tau_0 was found to correlate with TMB^+-water interactions measured by electron spin echo modulation experiments. 13 references, 4 figures.

1104 **Synthesis and characterization of disulfonated thionines. Redox mediators for electrochemical energy conversion systems.** Albery, W.J.; Bartlett, P.N.; Lithgow, A.M.; Riefkoehl, J.L.; Rodriguez, L.A.; Romero, L.; Souto, F.A. (Imperial College, London, England). *Journal of Organic Chemistry;* **50**: No. 5, 596-603(8 Mar 1985). Contract AS05-82ER12088.

A general synthetic strategy for the preparation of disubstituted thionines is described. A new method based on the nucleophilic coupling of a p-phenylenediamine with the synthetic equivalent of an aniline has resulted in considerable improvement, regarding particularly the suppression of byproducts (15-20% yield). The relatively low yields obtained still with the new route are an indication that thionation and ring closure of diphenylamines are difficult when electron-withdrawing groups are present. The new route has enabled the unambiguous structural characterization of two isomeric DST's known as DST-1 and DST-2 to be 4,6- and 2,6-DST, respectively. The 470-MHz ^1H NMR and the UV-vis spectra for thionine, 2,6-DST, and 4,6-DST are reported. The effect of the sulfonates in the visible region has been slightly hypsochromic, the λ/sub max/ not deviating much from that of thionine. This shift has been accounted for in terms of Dewar's rules for substituent effects in the UV-vis spectrum of odd alternate aromatic hydrocarbons. The effect in diffusion and extinction coefficients has been negligible. Disulfonation has resulted in an increased solubility in 50 mM H_2SO_4 (about 10^{-3} M) and less tendency to form ground-state molecular aggregates, around 10^{-4} M, compared to thionine, 10^{-4} and 10^{-6} M, respectively. It is concluded that it is potentially possible to design dye derivatives with improved characteristics while maintaining the best existing basic features of thionine. Derivatization of thionine with anionic substituents has permitted its solubilization in positively functionalized surfactant assemblies. This is not possible with the parent cationic thionine and can provide much higher solubilities than those observed. 33 references, 1 figure, 2 tables.

1105 **Conformations of adducts and kinetics of binding to DNA of the optically pure enantiomers of anti-benzo(a)pyrene diol epoxide.** Geacintov, N.E.; Yoshida, H.; Ibanez, V.; Jacobs, S.A.; Harvey, R.G. (New York Univ., NY). *Biochemical and Biophysical Research Communications;* **122**: No. 1, 33-39(18 Jul 1984). Contract AC02-78EV04959.

Kinetic flow dichroism studies indicate that the (+) enantiomer of 7β, 8α - dihydroxy-9 α, 10α-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene physically bound at intercalative-type sites in double-stranded DNA undergoes covalent binding reactions to form adducts at external binding sites. The conformation of the non-covalent complex derived from the (-) stereoisomer is also intercalative in nature, but the conformations of the covalent adducts are heterogeneous and are characterized by both intercalative-type and external conformations. It is suggested that the distinctly higher biological activity of the (+) enantiomer relative to the activity of the (-) enantiomer may be related to the preponderance of 7,8,9-triol benzo(a)pyrene residues covalently linked to deoxyguanine and located at external binding sites in the DNA adducts.

1106 **Interdendritic spacing: Pt. 1. Experimental studies.** Somboonsuk, K.; Mason, J.T.; Trivedi, R. (Ames Laboratory-USDOE, Ames, IA). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 6, 967-976(Jun 1984).

Directional solidification experiments have been carried out in a succinonitrile-5.5 mol pct acetone system to characterize dendrite tip radius and interdendrite spacings as functions of growth rate and temperature gradient in the liquid. A maximum in primary dendrite spacing as a function of growth rate is observed; this maximum is found to occur at the dendrite-cellular transition velocity. A scaling law is shown to exist between the secondary dendrite arm spacing, $\lambda 2$, near the tipe and the dendrite tip radius, /RHO/, which is λ//RHO/ = 2.2 plus or minus 0.3. Experimental results on /RHO/ have been found to agree with the theoretical model based on the marginal stability criterion.

1107 **New phases and chemical reactions in solid CO under pressure.** Katz, A.I.; Schiferl, D.; Mills, R.L. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **88**: No. 15, 3176-3179(1984).

The Raman scattering of solid carbon monoxide was studied in a diamond cell from 15 to 297 K at pressures from 1.0 to 5.8 GPa. At low temperature a transition occurs near 3.4 GPa from the known α-phase (space group $P2_13$) to a new ϵ-phase (structure unknown), rather than to the predicted γ-phase ($P4_2$/mnm). A transformation from β-CO (space group $P6_3$/mmc) into a new σ-phase (Pm3n?) was found near 5.2 GPa at room temperature. Above about 4.6 GPa and 80 K, CO reacts photochemically when irradiated with visible laser light. The photoreactivity may be associated with the formation of a yellow polymer, which can be recovered at zero pressure. 31 references, 3 figures.

1108 **Structure and reactivity of cyclic enediol N-phosphorylazoles and N-phosphoryltetramethylguanidine.** Ramirez, F.; Ricci, J.S. Jr.; Okazaki, H.; Marecek, J.F.; Lewy, M. (State Univ. of New York, Stony Brook). *Phosphorus and Sulfur and the Related Elements;* **20**: 279-299(1984).

A series of cyclic enediol phosphorylazoles (CEP-azoles) derived from the 4.5-dimethyl-2-oxo-1,3,2-dioxaphosphole ring system and pyrrole, imidazole, pyrazole, 1,2,4-triazole and tetrazole have been prepared. The structures of CEP-triazole and of the related phosphoramidate CEP-tetramethylguanidine (CEP-TMG) have been determined by X-ray crystallographic analysis and compared with the known structure of CEP-imidazole. The reactions OF CEP-azoles and CEP-TMG with alcohols have been studied and compared with the reaction of CEP-esters, CEP-OR, with alcohols, R^3OH, under catalysis by the azoles or tetramethylguanidine. Relative rates of reactions and differences in product composition are discussed in terms of the formation of an oxyphosphorane intermediate in nucleophilic substitutions at 4-coordinate phosphorus. Differences in reactivities among the CEP-derivatives have been determined.

1109 **Structure of semiconducting 3,4;3',4'-bis(ethylenedithio)-2,2',5,5'-tetrathiafulvalene-hexafluoroarsenate (2:1), (BEDT-TTF)$_2AsF_6$, ($C_{10}H_8S_8$)$_2AsF_6$.** Leung, P.C.W.; Beno, M.A.; Blackman, G.S.; Coughlin, B.R.; Miderski, C.A.; Joss, W.; Crabtree, G.W.; Williams, J.M. (Argonne National Lab., IL). *Acta Crystallographica, Section C: Crystal Structure Communications;* **C40**: 1331-1334(1984). Contract W-31-109-ENG-38.

The structure of the organic conductor, 3,4; 3',4'-bis(ethylenedithio)-2,2',5,5'-tetrathiafulvalene-hexafluoroarsenate (2:1) has been determined, and the crystal parameters are reported for 1323 observed reflections. The structure consists of two-dimensional sheets of the organic molecules separated by AsF_6^- anions. Short S-S contact distances are found normal to the molecular stacks but not along the stacking direction. The material undergoes a low-temperature (a, 2b, c) phase transition above 125K.

1110 **International Union of Crystallography Commission on Charge, Spin and Momentum Densities project on comparison of structural parameters and electron density maps of oxalic acid dihydrate.** Coppens, P.; Dam, J.; Harkema, S.; Feil, D.; Feld, R.; Lehmann, M.S.; Goddard, R.; Krueger, C.; Hellner, E.; Johansen, H. (State Univ. of New York, Buffalo). *Acta Crystallographica, Section A: Crystal Physics, Diffraction, Theoretical and General Crystallography;* **A40**: 184-195(1984).

Results obtained from four X-ray and five neutron data sets collected under a project sponsored by the Commission on Charge, Spin and Momentum Densities are analyzed by comparison of thermal parameters, positional parameters and X-N electron density maps. Three sets of theoretical calculations are also included in the comparison. Though several chemically significant features are re-

produced in all the experimental density maps, differences in detail occur which caution against over interpretation of the maps. Large differences between vibrational tensor elements U/sub ij/ are observed which can often not be corrected by the scaling of all temperature parameters in a set. Positional parameters are reproducible to precisions of 0.001 A or better. The biggest discrepancies between theoretical and experimental deformation density maps occurs in the lone-pair regions where peaks are higher in the theoretical maps. However, this comparison may be affected by inadequacies in the thermal-motion formalism which must be invoked before experimental and theoretical maps can be compared in a quantitative way.

1111 **Mechanisms of reaction of benzo(a)pyrene-7,8-diol-9,10-epoxide with DNA in aqueous solutions.** Geacintov, N.E.; Hibshoosh, H.; Ibanez, V.; Benjamin, M.J.; Harvey, R.G. (New York Univ., NY). *Biophysical Chemistry;* **20**: 121-133(1984). Contract AC02-78EV04959.

The physical and chemical reaction pathways of the metabolite model compound benzo(a)pyrene-7,8-diol-9,10-epoxide (BPDE) in aqueous (double-stranded) DNA solutions was investigated as a function of temperature (0-30°C), pH (7.0-9.5), sodium chloride concentration (0-1.5M) and DNA concentration in order to clarify the relationships between the multiple reaction mechanisms of this diol epoxide in the presence of nucleic acids. The reaction pathways are (1) intercalative complex formation with DNA, characterized by the equilibrium constant K, and X/sub b/ the fraction of molecules physically bound; (2) accelerated hydrolysis of BPDE bound to DNA; (3) covalent binding to DNA; and (4) hydrolysis of free BPDE (k/sub h/). The DNA-induced hydrolysis of BPDE to tetraols and the covalent binding to DNA are parallel pseudo-first-order reactions.

1112 **^{13}C NMR conformational analysis of 9,10-dihydroanthracene monoanions.** Rabideau, P.W.; Wetzel, D.M.; Husted, C.A.; Lawrence, J.R. (Indiana Univ., Indianapolis). *Tetrahedron Letters;* **25**: No. 1, 31-34(1984). Contract AC02-79ER10339.

9,10-dihydroanthracene-Li (DHA-Li) and tert-butyl 9,10-dihydroanthracene-Li were generated by proton abstraction with n-butyllithium in tetrahydrofuran followed by evaporation to dryness and addition of anhydrous ammonia. Chemical shifts and one bond ^{13}C-H coupling constants at the anionic center were determined and are presented in tabular form. Results of studies of DHA anions reported here indicate that the anions vibrate near or around a planar geometry with sp^2 hybridization at C/sub α/. The large t-butyl substitutent seems to have little effect on the geometry of the anion as evidenced by ^{13}C NMR data.

1113 **Crystalline organomercuric acetates via organoboranes.** Kunda, S.A.; Varma, R.S.; Kabalka, G.W. (Univ. of Tennessee, Knoxville). *Synthetic Communications;* **14**: No. 8, 755-760(1984). Contract AS05-80EV10363.

It is shown that the organomercuric acetates (OMA) can be synthesized rapidly using organomercury derivatives as intermediates. The OMAs can be readily prepared as crystalline solids. The reactions proceed with sufficient rapidity to make the synthesis useful for isotopic labelling of physiologically active compounds.

1114 **New approach to the air oxidation of alkenes employing metal nitro complexes as catalysts.** Andrews, M.A.; Chang, T.C.T.; Cheng, C.W.F.; Kelley, K.P. (Brookhaven National Lab., Upton, NY). *Organometallics;* **3**: No. 12, 1777-1785(1984).

Alkenes are stoichiometrically and, in the presence of air, catalytically oxidized by cis-bis(aceto-nitrile) chloronitropalladium(II). Oxidation of monosubstituted terminal alkenes and trans-cyclooctene yields the corresponding ketone, oxidation of cyclopentene and cyclohexene the corresponding allyl alcohol, and oxidation of bicyclic alkenes the corresponding epoxide, each with good selectivity for the respective product. Other alkenes give varying mixtures of the above products together with, in some cases, the α,β-unsaturated ketone. Vinyl ethers yield the corresponding ester while (trimethylsily)ethylene yields (trimethylsilyl)acetaldehyde. The selectivities are rationalized on the basis of ease of β-hydrogen elimination in observed intermediate heterometallacyclopentane complexes formed by nucleophilic attack of the nitro oxygen atom on the coordinated alkene in alkene nitro complexes. The general role of metallacycles in metal-mediated alkene oxidations and the advantages and disadvantages of intra- vs. intermolecular metal nitro catalyzed alkene oxidations are discussed. 50 references, 4 figures, 3 tables.

1115 **Application of the nucleophilic substitution reaction to the synthesis of no-carrier-added (^{18}F)fluorobenzene and other ^{18}F-labeled aryl fluorides.** Shiue, C.Y.; Watanabe, M.; Wolf, A.P.; Fowler, J.S.; Salvadori, P. (Brookhaven National Lab., Upton, NY). *Journal of Labelled Compounds and Radiopharmaceuticals;* **21**: No. 6, 533-547(1984).

No-carrier-added (^{18}F)fluorobenzene was prepared in a multistep synthesis with a radiochemical yield of 20-30%. A series of no carrier added and carrier added ^{18}F-labeled aryl fluorides which are important precursors of ^{18}F-labeled butyrophenone neuroleptics have also been synthesized in radiochemical yields of 30-50%. The direct synthesis of (^{18}F)spiroperidol and (^{18}F)benperidol from the parent compounds and/or nitro and/or chloro compound using the nucleophilic substitution reactions were also investigated.

1116 **Determination of interparticle structure factors in ionic micellar solutions by small angle neutron scattering.** Bendedouch, D.; Chen, S.H.; Koehler, W.C. (Massachusetts Institute of Technology, Cambridge). *Journal of Physical Chemistry;* **87**: 2621-2628(1983).

A series of small-angle neutron-scattering (SANS) intensity measurements were carried out on aqueous micellar solutions of ionic detergent lithium dodecyl sulfate (LDS). A systematic study of the system was conducted as a function of both detergent concentration, from 0.008 to 1.107 M, and salt (LiCl) concentration, from 0.0 to 1.0 M, at around 37°C. The data show that LDS micelles stay small within this range of solution conditions, and therefore analysis can be made regarding the micelles as approximately monodisperse macroions suspended in a solution of given ionic strength I. The SANS spectra exhibit a pronounced interaction peak due to strong intermicellar Coulombic repulsions, especially at low I. Analysis is made by using a mean spherical approximation (MSA) for a model charged hard-sphere system to compute the interparticle structure factor S(Q), and a uniform prolate spheroidal structure for the micellar core to model the intraparticle structure factor P(Q). Excellent agreement is obtained between our data and this model using only two free parameters.

1117 **(K-Trans—301) Improved amphoteric ion exchanger and its manufacturing method.** Kodaka, Tadao; Onuma, Hiroshi. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). [1985]. Contract AC05-84OT21400. Translation of Japanese Patent 59-105,848, June 19, 1984. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001608.

This invention relates to an amphoteric ion exchanger comprising a block copolymer composed of a polymer chain poly A^- having a cation exchange group, poly B^+ polymer chain having an anion exchange group, and poly C polymer chain not having an ion exchange group, among which the constituent poly chain C is produced by adding hydrogen to a diene-group polymer. A multiphased structure material having both regions of cation and anion exchange groups is expected to provide an unusual characteristic because of its effect of fixed level of amphoteric electric charge. An amphoteric ion exchange is to be manufactured with the use of a three-dimensional block copolymer having a diene-group polymer chain as a constituent block capable of being easily bridgeable without introducing an ion exchange group in addition to the use of polymer chains to which a cation or anion exchange can be introduced. This method requires, at the same time, very careful selections of reaction conditions for sulfonizing the added diene-group polymer, which does not have sufficient chemical strength. The present inventors have found that an amphoteric ion exchange with excellent chemical strength can be manufactured by hydrogenating the polydiene group region of a block copolymer, consisting of three constituents having such a diene-group polymer chain. 3 figs.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 21, 31, 798

1118 (LA-UR—85-3253) Combined electrochemical/surface science investigations of Pt/Cr alloy electrodes. Daube, K.A.; Paffett, M.T.; Gottesfeld, S.; Campbell, C.T. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 21p. (CONF-851174—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000765.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

Chromium addition improves the performance of carbon-supported Pt electrodes for oxygen reduction in phosphoric acid fuel cells. To clarify the role of chromium and its chemical nature at the electrode surface, we have performed a combined electrochemical/surface science investigation of a series of bulk Pt/sub x/Cr/sub (1-x)/ alloys ($0 \leqq x \leqq 1$). In this paper we report the surface characterization of the starting electrodes by XPS, electrochemical results from cyclic voltammetry in 85% phosphoric acid, and post-electrochemical surface characterization. For Cr contents less than 40%, the electrodes were quite stable up to +1.6 V vs DHE. The surface Cr was largely oxidized to Cr^{+3} for surfaces at open circuit ad those exposed at potentials $< +1.4$ V. For intermediate Cr levels, Cr was leached from the surface region by +1.5 V, leaving a porous Pt electrode with increased electrochemical hydrogen adsorption capacity. For Pt/sub 0.2//Cr/sub 0.8/, treatments at +1.4 V and above led to the appearance of Pt^{4+} and Cr^{6+} species, apparently stabilized in a porous phosphate overlayer up to 50 A thick. The Pt electrochemical hydrogen adsorption capacity was simultaneously increased by a factor of 15. 18 refs., 4 figs.

1119 Photo-oxidation of organic compounds at doped α-Fe_2O_3 electrodes. Kennedy, J.H.; Dunnwald, D. (Univ. of California, Santa Barbara). *Journal of the Electrochemical Society;* **130**: No. 10, 2013-2016(Oct 1983).

Photo-oxidation of organic compounds at doped α-Fe_2O_3 electrodes was investigated in aqueous and nonaqueous solutions. Oxalic and formic acids in 0.5M H_2SO_4 showed distinctly different reactivities. Photo-oxidation of alcohols, e.g., methanol and 2-propanol, was investigated in propylene carbonate and compared to their oxidation in water. The oxidation products (formaldehyde, acetone, and oxygen) were analyzed quantitatively; they accounted for 100% of the current. Competition between methanol and 2-propanol, and between these alcohols and water, is also reported. 18 references, 8 figures.

1120 Controlling the duration of photosynthetic charge separation with microwave radiation. Wasielewski, M.R.; Bock, C.H.; Bowman, M.K.; Norris, J.R. (Argonne National Lab., IL). *Nature (London);* **303**: No. 5917, 520-522(9 Jun 1983). Contract W-31-109-ENG-38.

Electron transfer reactions are commonplace in both chemical and biochemical transformations. These reactions generally involve the formation of transient radical ion pairs. Non-adiabatic electron transfer results in formation of a correlated radical ion pair. Only when the radical ions have separated to distances of the order of 10 A are the internal magnetic fields in the radical ions able to perturb this correlation. Thus radical pairs initially born in a singlet state will develop triplet character as a function of time, and vice versa. Because the ensuing chemistry of the radicals is dependent on their spin state, external perturbations of the radical pair spin state may permit some control over the course of the chemistry. Microwave radiation can provide a strong internal magnetic field perturbation on a radical pair such as the one that results from photoinduced charge separation in bacterial reaction centers. It is shown how this perturbation can be used to control the lifetime of the initially formed radical pair. 6 references, 2 figures.

1121 Competition reactions at α-Fe_2O_3 photoanodes. Shinar, R.; Kennedy, J.H. (Univ. of California, Santa Barbara). *Journal of the Electrochemical Society;* **130**: No. 4, 860-863(Apr 1983).

Photoanodic oxidation of iodide and bromide ions at polycrystalline doped α-Fe_2O_3 electrodes in competition with oxygen production was investigated in the pH range 0-13 in aqueous media. It appears that at high pH values only iodide oxidation could compete effectively with water oxidation. However, in addition to the photoelectrochemical oxidation of iodide, evidence for secondary reactions involving electrogenerated species was observed mainly in highly basic solutions. Adsorption of I^- plays a significant role in the reaction as well as in the photoelectrochemical properties of α-Fe_2O_3. α-Fe_2O_3 photoanodes were found to be stable under illumination in solution at pH 0 with or without the presence of bromide ions. 13 references, 5 figures, 1 table.

1122 Photoelectrolysis of water at α-Fe_2O_3 electrodes in acidic solution. Kennedy, J.H.; Anderman, M. (Univ. of California, Santa Barbara). *Journal of the Electrochemical Society;* **130**: No. 4, 848-852(Apr 1983).

Photocurrent-potential curves at polycrystalline α-Fe_2O_3 electrodes in acidic solutions are reported to be similar to those found in basic solutions. Faradaic collection efficiency of 100% for photoelectrolyzed oxygen has been achieved in a closed cell configuration. Stable photocurrents have been demonstrated in various acidic media, and trace amounts of Fe(III) detected in the working solutions gave an indication of the dissolution rate. The stability of the αFe_2O_3 electrode is discussed and compared to other metal oxide photoanodes. 25 references, 5 figures, 1 table.

1123 Open-circuit photopotentials at doped α-Fe_2O_3 electrodes in aqueous solution. Shinar, R.; Kennedy, J.H. (Univ. of California, Santa Barbara). *Journal of the Electrochemical Society;* **130**: No. 2, 392-396(Feb 1983).

The influence of redox couples in aqueous solution on the interface energetics of chemically and thermally doped polycrystalline α-Fe_2O_3 photoanodes has been investigated. Experiments were carried out at several pH values. Results are compared to those obtained from a single crystal electrode. It is shown that the potential of the semiconductor under illumination shifts toward positive values when the energy level of the redox couple in solution is increased. The role that grain boundaries in the sintered electrodes may play, the effect of pH and the redox couple concentration are discussed. 16 references, 5 figures, 1 table.

4005 Photochemistry

REFER ALSO TO CITATION(S) 303, 395, 1103, 1107

1124 (BNL—36894) Studies involving the reduction of SOD-Cu^{2+} by CO_3^- radicals. Cabelli, D.E.; Bielski, H.J. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-8509146—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001204.

From 4. international conference on superoxide and superoxide dismutase; Rome, Italy (1 Sep 1985).

Pulse radiolysis and other radiolytic techniques have proven very potent tools in the elucidation of the mechanism of O_2^- dismutation by superoxide dismutases (SOD). Some recent work in this laboratory involved a systematic study of the reduction of SOD-Cu^{2+} (bovine liver) by CO_3^- radicals and the kinetics of the interaction between the resultant SOD-Cu^+ and peroxide, a process that is known to inactivate the enzyme and thought to generate a bound OH radical. 9 refs., 1 fig., 1 tab.

1125 (DOE/ER/70277—T2) Energy transformations in organometallic complexes. Progress report, July 1, 1984-September 31, 1985. Watts, R.J. (California Univ., Santa Barbara (USA). Dept. of Chemistry). 1985. Contract AT03-78ER70277. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000333.

The primary purpose of research projects performed during this report period was to characterize the fundamental photoproperties of a variety of ortho-metalated species. The proposal which was submitted and approved in 1984 describes our initial work on dichloro-bridged dimeric complexes of Ir(III) and Rh(III) with 2-phenylpyridine (ppy) and benzo[h]quinoline (bzq). During 1985 efforts have been expanded to incorporate the additional metal centers, Re(1) and Pd(II), as well as different ortho-metalating ligands including 3-methyl-2-phenylpyridine (mppy), 2-(p-tolylpyridine)

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(tpy), azobenzene (azb) and 2-phenylpyrimidine (ppyr). In addition, several new, mononuclear complexes of Ir(III) and Rh(III) with various combinations of metallated ppy or bzq and coordinated 2,2'-bipyridine (bpy) or 1,10-phenanthroline (phen) ligands have been prepared and studied. The goals of studies of these complexes are to provide a basis for evaluating their potential application as photocatalysts and to generally provide initial characterizations of the effects of metal-carbon sigma bonds on the identity, photophysics, and photochemistry of their low energy excited states. For purposes of organization the work described in this report is divided into four projects corresponding to the four graduate students who are currently working in this program. 2 figs., 2 tabs.

1126 **Photochemical transformations. 39. Effects of ring substituents and leaving groups on photo-Wagner-Meerwein rearrangements and their ground-state analogues.** Cristol, S.J.; Aeling, E.O. (Univ. of Colorado, Boulder). *Journal of Organic Chemistry;* **50**: No. 15, 2698-2707(26 Jul 1985). Contract AC02-79ER10366.

A variety of diarobicyclo(2.2.2)octa-2,5-dienes, substituted on the saturated bridge at C-7 or disubstituted at C-7 and C-8, have been subjected to direct irradiation in acetic acid, as well as to ground-state solvolysis. The ground-state reactions proceed as anticipated, occurring with preferred loss of the nucleofuge anti to the better participating ring, or with loss of the better nucleofuge, and with clean anti Wagner-Meerwein rearrangement to the diarobicyclo(3.2.1)octadienyl system, with one exception. The photoreactions proceed with reaction at the more readily reduced carbon-nucleofuge bond (chloride loss rather than methanesulfonate) with the dibenzo system. The (methylsulfonyl)oxy group is photoinert with both benzo rings unsubstituted but is photoactive with the better electron-donating veratrolo ring. The photo-Wagner-Meerwein rearrangements and photosolvolyses all proceed with preponderant or stereospecific syn migration, in contrast to the ground-state reactions. The photoreactivities are consistent with the requirement that electron transfer of an excited π^* electron to the σ/sup */ orbital of the carbon-nucleofuge bond must occur faster than electron-demotion processes occur. The stereochemical results are accommodated by the assumption that the resulting zwitterionic biradical has two possible competing fates leading to products. One involves loss of nucleofuge concerted with a syn 1,2-migration, and the other is a nonconcerted process in which loss of nucleofuge results in formation of a biradical cation, which is nonstereospecific in its ultimate rearrangement. 30 references, 10 figures.

1127 **Flash photolysis of transient radicals. 1. X_2p with X = Cl, Br, I, and SCN.** Nagarajan, V.; Fessenden, R.W. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **89**: No. 11, 2330-2335(23 May 1985).

The radicals Cl_2^-, Br_2^-, I_2^-, and $(SCN)_2^-$ were prepared by photolysis of appropriate chemical systems with one laser and were subsequently photolyzed with a second laser. The first three species were photolyzed at 355 nm, and $(SCN)_2^-$ was photolyzed at 532 nm, I_2^- was also photolyzed at 700 nm. In each case, dissociation into the fragments X and X^- was detected by a bleach in the absorption of X_2^-. In no case was electron photodetachment observed. Observation of the recovery of the original absorption allowed the corresponding rate constant to be measured. In the case of Cl_2^- the bleach in absorption does not completely recovery and the loss of absorption is dose dependent. Because the presence of acid allows a more complete recovery, it can be concluded that the product Cl atom is photolyzed by a second photon to produce OH and Cl^-. This photoreaction is direct experimental evidence that the absorption band of Cl involves charge transfer from solvent. Detailed analysis of the bleaching and recovery behavior at high Cl^- concentrations showed no time lag which could be attributed to the ^2P/sub 1/2/ Cl atom, implying a short lifetime for this species. 13 references, 6 figures, 2 tables.

1128 **Photoionization thresholds of chlorophyll a and N,N,N',N'-tetramethylbenzidine in vesicle and micelle frozen solutions.** Ohta, N.; Kevan, L. (Univ. of Houston, TX). *Journal of Physical Chemistry;* **89**: No. 11, 2415-2419(23 May 1985). Contract AS05-80ER10745.

Photoionization of chlorophyll a (Chla) and N,N,N',N'-tetramethylbenzidine (TMB) in rapidly frozen vesicle and micelle solutions at 77 K has been studied with detection of the Chla and TMB cation radicals by electron spin resonance. The photoionization threshold of Chla in DL-α-dipalmitoylphosphatidylcholine (DPPC) vesicles is about 0.2 eV less than the threshold in anionic and cationic micelles. The decrease is discussed in terms of differences in the cation polarization energy and the quasi-free electron energy level. The photoionization threshold of TMB is similar in micelles and vesicles. The difference between Chla and TMB may be due to different extents of their penetration into micelles and vesicles. 39 references, 4 figures, 1 table.

1129 **Energy transfer among the chromophores of c-phycocyanin from Anabaena variabilis using steady state and time-resolved fluorescence spectroscopy.** Switalski, S.C.; Sauer, K. (Lawrence Berkeley Lab., CA). *Photochemistry and Photobiology;* **40**: No. 4, 423-427(1984). Contract AC03-76SF00098.

The model of energy transfer between sensitizing (s) and fluorescing (f) chromophores for the $\alpha\beta$ monomer and for the separated α and β subunits of the C-phycocyanin from Anabaena varibilis using fluorescence emission spectroscopy, fluorescene excitation polarization, and picosecond-resolved fluorescence decay kinetics has been investigated. The fluorescence emission maximum occurs at 640 nm for all samples. The fluorescene excitation polarization is constant (P=0.40) across the absorption band for the α subunit, but it increases across the absorption band towards longer wavelength for the β subunit and the $\alpha\beta$ monomer. The fluorescence decay kinetics exhibit two exponential lifetimes of 1.3-1.5 ns and 340-500 ps for the $\alpha\beta$ monomer and for the α and β subunit preparations. The change in polarization across the absorption band energy/transfer among the three chromophores in the $\alpha\beta$ monomer and among the two chromophores in the separated β subunit. The constant, relatively high polarization in the separated α subunit, having only one chromophore, is consistent with the absence of both energy is attributed to transfer and chromophore rotation. The concentration of the α subunit did not affect the decay kinetics, suggesting that the short lifetime component does not arise from aggregation of the α subunits. The biexponential decay kinetics of the α subunit cannot be explained using the sensitizing-fluorescing model. The possibility of conformational interactions is under investigation.

1130 **Methyl viologen aggregation.** Ebbesen, T.W.; Ohgushi, M. (Univ. of Notre Dame, IN). *Photochemistry and Photobiology;* **38**: No. 2, 251-252(1983).

Methyl viologen (paraquat, 1,1'-dimethyl-4,4'-bipyridinium dichloride) has been observed to start forming aggregates in methanol at 2.5 x 10^{-3}M, and in aqueous solutions at about 10^{-2}M depending on other experimental parameters. The number of molecules per aggregate is 2-3 for concentrations < 0.1 M.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 1102

1131 **(BNL-NCS—36966) Radiation effects.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 3p. (CONF-8508138—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001166.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

For the meeting of the Commission on Radiochemistry and Nuclear Techniques our chairman has submitted comments on potential problems that the Commission should consider in Lyon which had been posed by various members. In one of these comments, Prof. Roth has mentioned the problem of radiation effects in solids and in water and water solutions. The radiolysis of water has been of concern for a large number of years, but as Prof. Roth notes, the radiation effects on the first wall of fusion reactors is a problem that has arisen only in recent years and for which no critical data compilation is presently available. This paper has been prepared in response to Prof. Roth's comments and indicates a possible area, which the Commission might conceivably address at this meeting and/or in the near future. 7 refs.

1132 **(CEA-CONF—7829) HPLC/EPR study of sugar-nitroxide radicals.** Vincent, P.; Agnel, J.P.; Thiery, C.; Boizot, C.; Raffi, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). 1984. 5p. (CONF-8406286—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780108.

From HPLC meeting; Fontenay-aux-roses, France (14 Jun 1984).

Gamma radiation induces in glucose and its oligomers radicals whose powder EPR spectra are unresolved; compounds like the tertio butyl nitroso convert these radicals into long lived nitroxide adducts, in liquid medium. The relative spectra consist in multiple overlapping signals; the HPLC combined with an EPR spectrometer, used as a detector, allows a separation of radicals or groups of radicals: thus, the series of recorded EPR spectra are easier to be simulated and interpreted.

1133 **EPR study of a vinyl-type radical in X-irradiated β-carotene.** Joseph, J.; Samskog, P.O.; Lee, S.H.; Kispert, L.D. (Univ. of Alabama, Tuscaloosa). *Journal of Physical Chemistry;* **89**: No. 10, 2010-2012(9 May 1985).

A vinyl-type radical with proton EPR couplings of 68 and 72 G has been observed at -40°C as a secondary radical formed when a sample of trans-β-carotene powder is X-ray irradiated at 77 K in the dark and warmed. An INDO/CI calculation suggests that it is due to the loss of a proton from the 15 or 15' position. 22 references, 3 tables.

1134 **Site selective excitation of 1-hydronaphthyl radical in irradiated naphthalnene crystal.** Nakayama, T. (Univ. of Notre Dame, IN). *Journal of Luminescence;* **28**: 313-317(1983).

Fluorescence excitation spectrum of the 1-hydronaphthyl radical is observed by site selective laser excitation. The proposal by Jacobsen et al., that the origin of the radical is dual, is confirmed.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 145, 257, 497, 1030, 1036

1135 **(BNL-NCS—36964) Status of the lanthanides and actinides in the periodic table.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 3p. (CONF-8508138—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001188.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

In extended discussions and correspondence with Ekkehard Fluck, the author was made aware of a problem with the Periodic Table, i.e., which element should be shown in the main table as the representative of the lanthanide series and the actinide series. In earlier discussion, he came to the conclusion that lanthanum and actinium are not the elements which should appear, but rather lutetium and lawrencium are more appropriate for inclusion in their place. This paper will attempt to justify the reasons for the above conclusions. 4 refs.

1136 **(CEA-CONF—7501) Production of americium isotopes in France.** Koehly, G.; Bourges, J.; Madic, C.; Nguyen, T.H.; Lecomte, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Dec 1984. 19p. (CONF-841210—26). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752896.

From International chemical congress of Pacific Basin Society; Honolulu, HI, USA (16 Dec 1984).

The program of productions of americium 241 and 243 isotopes is based respectively on the retreatment of aged plutonium alloys or plutonium dioxide and on the treatment of plutonium targets irradiated either in CELESTIN reactors for Pu-Al alloys or OSIRIS reactor for plutonium 242 dioxide. All the operations, including americium final purifications, are carried out in hot cells equipped with remote manipulators. The chemical processes are based on the use of extraction chromatography with hydrophobic SiO_2 impregnated with extracting agents. Plutonium targets and aged plutonium alloys are dissolved in nitric acid using conventional techniques while plutonium dioxide dissolutions are performed routine at 300 grams scale with electrogenerated silver II in 4M HNO_3 at room temperature. The separation between plutonium and americium is performed by extraction of Pu(IV) either on TBP/SiO_2 or $TOAHNO_3/SiO_2$ column. Americium recovery from waste streams rid of plutonium is realized by chromatographic extraction of Am(III) using mainly TBP and episodically DHDECMP as extractant. The final purification of both americium isotopes uses the selective extraction of Am(VI) on HDDiBMP/SiO_2 column at 60 grams scale. Using the overall process a total amount of 1000 grams of americium 241 and 100 grams of americium 243 has been produced nowadays and the AmO_2 final product indicates a purity better than 98.5%.

1137 **(CEA-CONF—7813) Raman spectroscopic investigations of aqueous thorium (IV) thiocyanate complexes.** Livet, J.; Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Feb 1985. 2p. (CONF-8502100—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752895.

From 15. meeting on actinides; Liege, Belgium (26 Feb 1985).

Thiocyanate form aqueous complexes with the actinides ions in all their oxidation states. Results obtained with Raman spectroscopy are reported. This technique allows changes to be observed in the ligand internal vibration energies. These changes are due to inner sphere complex formation. When SCN^- is bonded to Th(IV) the νsub(C-S) stretching band is shifted from 751 to 812 cm^{-1} and the νsub(C-N) stretching from 2064 cm^{-1} to 2069 cm^{-1}. This shifts indicates that SCN^- is bonded by the nitrogen. The formation constants found are smaller than for U(IV) showing that the ionic part of the bond is not negligible.

1138 **(DOE/EV/10363—7) Synthesis of radiopharmaceuticals containing short-lived radionuclides. Progress report, March 1, 1985-February 26, 1986.** Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Sep 1985. Contract AS05-80EV10363. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001891.

Methods for the rapid introduction of short-lived radionuclides into agents for use in diagnostic nuclear medicine are reported. Methods to synthesize radioiodinated fatty acids, lipids, and amphetamine derivatives are described. New routes for the introduction of bromine-77, chlorine-34m, and carbon-11 into agents of interest are elaborated. 46 refs.

1139 **(DOE/EV/10363—8) Synthesis of radiopharmaceuticals containing short-lived radionuclides. Comprehensive report, March 1, 1980-February 26, 1986.** Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Sep 1985. Contract AS05-80EV10363. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001889.

New methods for the rapid introduction of short-lived radionuclides into agents for use in diagnostic nuclear medicine are reported. Among the new syntheses reported are those for ^{123}I-labeled fatty acids and steroids, for ^{11}C-labeled alcohols, for ^{13}N-labeled amines, and for ^{15}O-labeled alcohols. 33 refs.

1140 (INIS-BR—304, pp 70-71) **Comparative study between /sup 99m/Tc pyrophosphate preparations when stannous chloride or stannous ascorbate is used as reducing agent of /sup 99m/TcO-4 ion.** Barbosa, M.F. de; Colturato, M.T.; Silva, C.P.G. da (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86780055. (CONF-8404259—Absts.).

From 4. congress of the Brazilian Society of Biology and Nuclear Medicine; Porto Alegre, Brazil (28 Apr 1984).

Published in summary form only.

1141 (INIS-mf—9364) **Fluorination of solid UF_6 decomposition products by gaseous mixtures of $CBrF_3$ and F_2.** Maner, A. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). 7 Jul 1983. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780019.

Gaseous mixtures of $CBrF_3$ and F_2 exhibit some advantages in the removal of solid UF_6 decomposition products from uranium enrichment installations. To facilitate optimal application, the self decomposition of these mixtures as well as their interactions with uranyl fluoride have been studied in a stainless steel cell equipped with AgCl windows for IR analysis. It has been found that self decomposition with low F_2 content causes BrF_3 to show up besides the common reaction products, BrF_5 and CF_4. The fluorination of uranyl fluoride results in a retardation of the BrF_5 formation as compared to the formation of CF_4 due to a temporary accumulation of bromine in low valency states on the surface of the solid uranium compound. The reaction rate for the fluorination of uranyl fluoride increases within certain limits with decreasing F_2 content of the mixture. For the practical application of the more reactive mixtures with low F_2 content it is important that, after total consumption of F_2 the residual $CBrF_3$ may attack the UF_6 formed by fluorination of the solid uranium compound. Therefore, F_2 has to be added or the mixture has to be pumped off in time. To verify the practical usefulness of the gas mixtures, technical separation nozzle elements have been polluted artificially with UF_6 reduction and hydrolysis products and afterwards exposed to the gaseous $CBrF_3/F_2$ mixture in further experiments. The efficiency of the separation nozzle elements has been determined in separation experiments before and after the pollution as well as after the fluorination treatment. Furthermore, the condition of the separation elements has been recorded by scanning electron micrographs. It has been found that the treatment with the gaseous $CBrF_3/F_2$ mixture removes the dust deposits even under the geometrically disadvantageous conditions of the narrow separation nozzle structures. (orig.).

1142 (INIS-mf—9472, pp 62) **Application of redox polymers in preparing /sup 99m/Tc-labelled compounds.** Kleisner, I.; Vrana, V.; Vacek, J. (Karlova Univ., Prague (Czechoslovakia). Lekarska Fakulta Hygienicka). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1143 (INIS-mf—9472, pp 75) **Development of injectable ^{67}Ga.** Kopecky, P. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1144 (INIS-mf—9472, pp 76) **Selection of characteristics of injectable ^{67}Ga.** Kopecky, P. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1145 (INIS-mf—9472, pp 82) **Electrochemical iodination of thyroxine and other compounds for RIA.** Kracmar, P. (Fakultni Nemocnice, Prague (Czechoslovakia). Oddeleni Nuklearni Mediciny). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1146 (INIS-mf—9472, pp 84) **Preparation of 5-iododeoxyuridine-^{131}I.** Kronrad, L.; Hadilek, P.; Kopicka, K. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1147 **Photophysical studies of uranyl complexes. VIII. Luminescence spectra of $UO_2SO_4.3\ 1/2H_2O$ and two polymorphs of bis(urea) uranyl sulfate.** Brittain, H.G.; Ansari, P.; Toivonen, J.; Niinisto, L.; Tsao, L.; Perry, D.L. (Seton Hall Univ., South Orange, NJ). *Journal of Solid State Chemistry;* **59**: No. 2, 259-264(2 Sep 1985). Contract AC03-76SF00098.

Photoluminescence spectra of hydrated and anhydrous uranyl sulfates have been studied under conditions of high resolution at cryogenic temperatures. All uranyl sulfate systems were found to yield nonequivalent spectra; the energies for the electronic and vibronic origins were found to vary with the system, and certain uranyl vibrational frequencies exhibited a dependence on environment. These differences must reflect the various ways in which the uranyl centers are linked by the bridging sulfate groups, as this linking is the main difference between the various structures. 6 references, 4 figures, 3 tables.

1148 **Considerations for the installation of an inductively coupled plasma for the analysis of radioactive samples.** Apel, C.T.; Gallimore, D.L. (Los Alamos National Lab., NM). pp 213-217 of Analytical spectroscopy. Lyon, W.S. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. ([1985]).

The sensitivity, dynamic range, and sample through-put rate attributes of the inductively coupled plasma (ICP) call for its consideration as the instrument of choice for the multielement analysis of radioactive samples. Based on our experience in handling radioactive materials, considerations will be presented concerning safety of the operator, modularity of the ICP-atomic emission spectrometer systems, reduction of the complex actinide spectra, atomization systems, drain and recovery systems, aerosol containment, heat dissipation, radiolysis effects of sample on dry-box environment, and liquid and solid sampling.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 854, 861

1149 **Shock tube investigation of major pathways in the high-temperature pyrolysis of benzene.** Kiefer, J.H.; Mizerka, L.J.; Patel, M.R.; Wei, H.C. (Univ. of Illinois, Chicago). *Journal of Physical Chemistry;* **89**: No. 10, 2013-2019(9 May 1985). Contract AC02-78ER04759.

The high-temperature pyrolysis of benzene, 1 and 2 mol % in krypton, has been studied in the shock tube with the laser-schlieren technique over 1900-2400 K and 0.2-1.0 atm. A completely successful modeling of the density gradient profiles and some time-of-flight mass spectra is achieved with a simple radical chain mechanism consisting of essentially just four reactions. The dissociation is solely CH bond scission (M) + $C_6H_6 \rightarrow C_6H_5 + H + (M)$ whose rates are strongly dependent on both temperature and pressure in this range; this reaction is near second order for $T > 2300$ K. An RRKM fit to this data suggests a barrier of 112 +/- 2 kcal/mol, which corresponds to $\Delta H/sub\ f/^\circ_{298} = 80$ +/- 2 kcal/mol for the phenyl radical heat of formation, and an average collisional energy transfer of (-ΔE)/sub all/ = 70 cm^{-1}. The extrapolated K/sub infinity/ for this reaction is $2 \times 10^{17} \exp(-118000\ (cal)/RT)\ s^{-1}$ (1900-2400 K). The model also indicates a rate constant of $2.5 \times 10^{14} \exp(-16000\ (cal)/RT\ cm^3/(mol\ s)$ (1900-2200 K) for the abstraction H + $C_6H_6 \rightarrow C_6H_5 + H_2$. 31 references, 9 figures, 3 tables.

1150 **Pyrolysis of benzene behind reflected shock waves.** Singh, H.J.; Kern, R.D. (Univ. of New Orleans, LA). *Combustion and Flame;* **54**: 49-59(1983). Contract AS05-79ER10505.

The pyrolysis of benzene was studied in the temperature and pressure range of 1400-2200K and 0.25-0.81 atm using a shock tube coupled to a time-of-flight mass spectrometer. The mixtures employed were 2.1 and 5% benzene diluted with neon, which yielded a carbon atom density range of (1.6-7.9) x 10^{17} atom cm^{-3} in the reflected shock zone. Products were analyzed by recording the mass spectra at 30 μs intervals during a total observation time of 700-1200 μs. C_2H_2, C_4H_2, and C_6H_2 were the major products produced during the decomposition. The only species having m/e > 78 were C_6H_2 and C_6H_6 (phenylacetylene), which were formed in relatively low concentrations and only at the high temperature end of the study. The product analysis was further substantiated by performing experiments with benzene-d6 mixtures under similar conditions. One important finding of this study was the observation that the phenyl radical was not detected above the threshold level of 10^{-10} - 10^{-11} mol cm^{-3} under the reaction conditions investigated. 35 references, 8 figures, 2 tables.

42 ENGINEERING

4201 General Engineering

1151 **(DOE/METC—85/4028) Mechanical interpretation of stochastic processes.** Komkov, V. (USDOE Morgantown Energy Technology Center, WV). Jul 1985. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013601.

In this report some well-known and some not-so-well known analogies between stochastic processes and mechanisms of rigid bodies are pointed out. The discussion of these analogies is kept at an elementary level.

1152 **(GAO/RCED—85-125) Status of a gas generator engine for the Coast Guard cutter Boutwell.** Peach, J.D. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 25 Jun 1985. 5p. US General Accounting Office, Box 6015, Gaithersburg, MD 20760. File Number TI86900089.

1153 **(SAND—85-1379C) Random variation of modal frequencies: experiments and analysis.** Paez, T.L.; Branstetter, L.J.; Gregory, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86000434.

The purpose of this investigation is to establish an analytic technique for the estimation of the second order statistical moments (mean, variance, covariance) of modal frequencies when one or more underlying structural parameters are random variables. (The moments of the underlying random variables are assumed to be known from experiments.) The results of a simple laboratory experiment are summarized to show that the analytic technique yields accurate results in a particular case. The analytical investigation summarized here shows that the moments of modal frequencies can be defined in terms of some simpler measure of structural characteristics. The second order moments of a structural system can be evaluated approximately. Some examples are presented. The first example shows the results of a sequence of experiments in which the fundamental frequency of a cantilever beam is evaluated repeatedly. The fundamental frequency varies randomly, and its mean and variance are estimated from measured data. In the same example, the mean and variance of an underlying random variable (base stiffness of the cantilever beam) are estimated from data, and it is shown that these moments can be used in the analytic framework developed here to estimate the mean and variance of the fundamental frequency. Good agreement exists between the experimental and analytical results. Two other numerical examples are presented to show how random variation occurs in higher modal frequencies and how random variation occurs when more than one underlying variable is random.

1154 **(SAND—85-2040C) Linked data bases contain parts explosion.** Carkeet, J.; Jones, D. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 15p. (CONF-8511105—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000433.

From Association of SYSTEM 2000 users for technical exchange (ASTUTE); Phoenix, AZ, USA (5 Nov 1985).

A data base has been developed to provide an automated audit of all components, modules, and subsystems for a Global Positioning System that consists of a constellation of 18 satellites. The data base includes detailed fabrication, test, and operational performance data. The objective is to mitigate the effects of an avalanche of paper audits from a production program involving a proliferation of subcomponents and to facilitate quality control of an extremely complex system. Four separate SYSTEM 2000 data bases that use redundant pointers are linked to provide many-to-many relationships and to minimize mainframe resource requirements. Updates of the four data bases are facilitated by a color-form entry capability on the IBM PC. Retrievals are simplified by a menu-driven query capability.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 137, 152, 155, 214, 528, 585, 753, 754, 1198, 1220, 1230, 1268, 1875, 1876, 1877, 1881, 1891, 1902, 1904

1155 **(BDX—613-3311) Motion analysis. Final report.** Glass, H.H. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Oct 1985. Contract AC04-76DP00613. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001126.

Advances in video sensor, magnetic recording head, and recording tape technologies have led to the introduction of a new high-speed video recording system. The motion analysis system is capable of recording real-time events at vvarious rates up to 2000 pictures per second and displaying the images at various reduced rates. An evaluation of the system has demonstrated that it provides the examination by other visual methods. Techniques developed to enhance the baseline capabilities have enabled the acquisition of device-performance data which has shortened the development period of electromechanical devices, and revealed details of high-speed manufacturing processes which could not be detected by the human eye.

1156 **(CONF-8505202—Vol.1-Exec.Summ.) NASA automation and robotics. Information exchange workshop: proceedings. Volume I, executive summary.** (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). 5 Jun 1985. 40p. NTIS, PC A03/MF A01. File Number DE85902195.

From NASA automation and robotics information exchange workshop; Houston, TX, USA (13 May 1985).

At the request of the NASA Space Station Program management, Level A of the Office of Space Station, the NASA Advanced Technology Advisory Committee (ATAC) held a workshop on advanced Automation and Robotics for all NASA Centers. The workshop was held at the Lyndon B. Johnson Space Center, Houston, Texas on may 13 through 17, 1985. The workshop addressed the research and development work in progress at the NASA Centers or under the sponsorship of the Centers. Work being done by civil servants, universities and industry personnel was all treated. The purposes of this workshop were: (1) to provide for an information exchange among all the participants in Automation and Robotics at the NASA Centers; (2) to give a report to NASA management on what is being done and by whom; and (3) to identify gaps in the overall A and R effort where an augmentation, if availalbel, would be beneficial. This document, Volume 1 of the Workshop Proceedings, presents the following: (1) a summary of workshop accomplishments and issues; (2) recommendations of the ATAC pursuant to the workshop; (3) brief descriptions of the papers presented; and (4) workshop participants. Volume 2 (in two parts, A and B) provides the full papers or other material presented in the workshop.

1157 **(CONF-8505202—Vol.2-Pt.A) NASA automation and robotics. Information exchange workshop: proceedings. Volume 2, Part A, presentations material.** (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). 1985. 529p. NTIS MF A01. File Number DE85902196.

From NASA automation and robotics information exchange workshop; Houston, TX, USA (13 May 1985).

Objective of the workshop were to produce an information exchange between the NASA centers on current efforts in advanced artificial intelligence, robotics, and automation and to provide the identification of current efforts throughout NASA, and gaps in the current efforts, in relation to Space Station automation and robotics. The agenda was a set of technical overview presentations from the NASA centers on current efforts in advanced artificial intelligence, robotics and automation, and a joint session with the (SSIS) workshop being held at JSC the same week.

1158 **(CONF-8505202—Vol.2-Pt.B) NASA automation and robotics. Information exchange workshop proceedings. Volume 2, Part B. Presentations material.** Erickson, J.D. (comp.). (National Aeronautics and Space Administration, Houston, TX (USA). Artificial Intelligence Office). 1985. 376p. NTIS, PC A17. File Number DE85902197.

From NASA automation and robotics information exchange workshop; Houston, TX, USA (13 May 1985).

Objectives of the workshop were to produce an information exchange between the NASA centers on current efforts in advanced artificial intelligence, robotics, and automation and to provide the identification of current efforts throughout NASA, and gaps in the current efforts, in relation to Space Station automation and robotics. The agenda was a set of technical overview presentations from the NASA centers on current efforts in advanced artificial intelligence, robotics and automation, and a joint session with the (SSIS) workshop being held at JSC the same week.

1159 **(GEPP-OP—723) Clean room history and training program.** Meeks, R.F. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1983. Contract AC04-76DP00656. 14p. (CONF-8304233—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000753.

From 16. annual symposium of the American Vacuum Society; Anaheim, CA, USA (11 Apr 1983).

An overview of the training program used by the General Electric Neutron Devices Department for clean room operators is presented. 31 figs.

1160 **(GEPP-OP—836) Particulate contamination control.** Meeks, R.F. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1984. Contract AC04-76DP00656. 9p. (CONF-841218—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001647.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

The basic purpose of the controlled environment is to prevent the entry of contaminants into the controlled atmosphere and to control conditions within the confined area to achieve a specific ambient atmosphere for the work. All factors that may influence the controlled environment must be taken into account. Primarily, the proper design and construction of the facility prevents external airborne contamination from entering the controlled atmosphere. The most elaborate efforts of clean room design and construction are quickly defeated if the entry of personnel and materials is not controlled. Personnel are usually the greatest single source of contaminants in a clean room. Among fifteen elements to be considered in creating operating procedures are: personnel activities, cleaning of materials prior to entrance, and control of special items such as paper and pencils. Obviously, many factors affect the clean room operation. A preventive maintenance program including comprehensive training and monitoring programs will eliminate unscheduled shutdowns.

1161 **(INIS-BR—299) Analysis of pipe mitred bends using beam models - by finite element method.** Salles, A.C.S.L. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Engenharia Mecanica). 1984. 104p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780039.

The formulation of a recently proposed displacement based straight pipe element for the analysis of pipe mitred bends is summarized in this work. The element kinematics includes axial, bending, torsional and ovalisation displacements, all varying cubically along the axis of the element. Interaction effects between angle adjoined straight pipe section are modeled including the appropriate additional strain terms in the stiffness matrix formulation and by using a penalty procedure to enforce continuity of pipe skin flexural rotations at the common helical edge. The element model capabilities are illustrated in some sample analysis and the results are compared with other available experimental, analytical or more complex numerical models. (Author).

1162 **(INIS-BR—300) Analysis of Warren and X-trussed continuous beam by equivalent stiffness matrices and moments of inertia.** Soares, J.M.D. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Escola de Engenharia). 1984. 175p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780040.

This work study the resolution of Warren and X-trussed continuous beams using equivalent stiffness coefficients and moments of inertia. The equilibrium equations in the generic Joint are obtained by finite differences method and the deflections and arbitrary static load equations are present in finite Fourier series form. The results of illustrative examples for both kinds of trussed beams are compared with solutions obtained with the Lorane Linear Program. The influence of panels number and comparisions with classic result of equivalent inertia are established. Abacus for X-trussed beams for stiffness coefficients obtained by series versus equivalent inertia stiffness coefficients and corrections using the top and bottom chords area are presented. (Author).

1163 **(LBL—19246) Two phase cooling for superconducting magnets.** Eberhard, P.H.; Gibson, G.A.; Green, M.A.; Ross, R.R.; Smits, R.G.; Taylor, J.D.; Watt, R.D. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1985. Contract AC03-76SF00098. 8p. (CONF-850814—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000619.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

A closed circuit tubular cooling system for superconducting magnets offers advantages of limiting boiloff and containing high pressures during quenches. Proper location of automatic valves to lower pressures and protect the refrigerator in the event of quenches is described. Theoretical arguments and exprimental evidence are given against a previously suggested method to determine He two phase flow regimes. If loss of flow occurs due to some types of refrigeration failure and transfer lines have enough heat leak to warm up, quenches are induced when the flow is restored. Examples are taken from experience with the TPC magnet.

1164 **(LBL—20054) Capacitor energy needed to induce transitions from the superconducting to the normal state.** Eberhard, P.H.; Ross, R.R. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 28p. (CONF-850920—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE86000604.

From 9. international conference on magnet technology; Zurich, Switzerland (9 Sep 1985).

The purpose of this paper is to describe a technique to turn a long length of superconducting wire normal by dumping a charged capacitor into it and justify some formulae needed in the design. The physical phenomenon is described. A formula for the energy to be stored in the capacitor is given. There are circumstances where the dc in an electrical circuit containing superconducting elements has to be turned off quickly and where the most convenient way to switch the current off is to turn a large portion or all of the superconducting wire normal. Such was the case of the Time Projection

Chamber (TPC) superconducting magnet as soon as a quench was detected. The technique used was the discharge of a capacitor into the coil center tap. It turned the magnet winding normal in ten milliseconds or so and provided an adequate quench protection. The technique of discharging a capacitor into a superconducting wire should have many other applications whenever a substantial resistance in a superconducting circuit has to be generated in that kind of time scale. The process involves generating a pulse of large currents in some part of the circuit and heating the wire up by ac losses until the value of the wire critical current is smaller than the dc current. Use of low inductance connections to the circuit is necessary. Then the dc gets turned off due to the resistance of the wire as in a magnet quench.

1165 **(LBL—20174) Concepts for insertion devices that will produce high-quality synchrotron radiation.** Halbach, K. (Lawrence Berkeley Lab., CA (USA)). Jul 1985. Contract AC03-76SF00098. 22p. (CONF-850734—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000621.

From 2. international synchrotron radiation instrumentation conference; Stanford, CA, USA (29 Jul 1985).

A simple analysis is presented that shows what effect the two major construction tolerances have on the field distribution in undulators, and it is shown that the consequential effects on the synchrotron radiation spectrum depend strongly on the type of undulator. A number of new conceptual undulator designs are described that allow electromagnetic correction of the field distribution in these undulators.

1166 **(NUREG/CR—2122) Improved criticality search techniques for low- and high-enriched systems.** Lorek, M.J. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract AC05-84OR21400. 61p. (ORNL/NUREG/CSD/TM—13). NTIS, PC A04/MF A01 - GPO. File Number TI86000883.

The purpose of this work is to develop a parameter search capability for use in criticality safety analysis of nuclear fuel shipping containers. This new search capability is being developed for use in the SCALE computer code system. SCALE is being developed for licensing evaluation of various transportation package designs. It can perform criticality safety analysis, shielding analysis, and heat transfer analysis on systems described in multi-dimensional geometry. The work described in this report is specifically concerned with the criticality safety analysis capability of SCALE, and particularly, with two sequences that will provide SCALE users with the option to perform criticality searches on systems described in either one-dimensional or three-dimensional geometries. This search package includes a method for an optimization search (maxima or minima) and a method for a fixed value search. The optimization search is a search for the most reactive state of a system. It searches for the value of a parameter, such as fuel assembly lattice pitch or fuel concentration, that corresponds to the maximum K-effective of the system. Similarly, the fixed value search is a search for the value of a parameter that corresponds to a fixed value of K-effective. Both searches rely on least squares curve fitting to obtain the information needed to make an estimate. Specifically, the data points are least squares fitted to a cubic polynomial which is solved analytically for parameter values that correspond to maximum or fixed values of K-effective. This new search capability has been implemented into a FORTRAN computer routine named OPTMIZ which is used to perform the parameter modifications in SCALE's two criticality search options. Results obtained from OPTMIZ show that fixed value criticality searching is greatly improved with regard to accuracy and computing cost relative to the existing search capability available in KENO-IV.

1167 **(PNL—5591) Gas leak characteristics of inner packaging components used in the D0T-Spec 6M container.** Taylor, J.M. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001117.

A test program was conducted by Pacific Northwest Laboratory to determine the gas leak characteristics of metal food pack cans and 2R vessels used to package radioactive material in a D0T 6M specification container. It can be concluded from the tests performed that the inner packaging components (2R vessel, metal product cans) used with a 6M container can be sealed so that they will be gas tight ($<10^{-5}$ cc/sec) under elevated temperature and pressure and impact conditions. To maintain gas tight seals under accident conditions, the metal cans must be sealed with a properly adjusted can-sealing machine; the threads of the 2R vessel must be luted with a sealing compound such as a silicone rubber compound; and the metal cans must be protected inside the 2R vessel with spacer plates and impact absorbers. 4 refs., 37 figs.

1168 **(PNL-SA—13357) Neutron source multiplication method.** Clayton, E.D. (Pacific Northwest Labs., Richland, WA (USA)). Aug 1985. Contract AC06-76RL01830. 36p. (CONF-8508105—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85017930.

From DOE subcritical reactivity measurements workshop; Albuquerque, NM, USA (26 Aug 1985).

The relationship between neutron multiplication and reactivity is briefly discussed and data presented to illustrate problems associated with the absolute measurement of neutron multiplication and reactivity in subcritical systems. A number of curves of inverse multiplication have been selected from a variety of experiments showing variations observed in multiplication during the course of critical and subcritical experiments where different methods of reactivity addition were used, with different neutron source detector position locations. The inverse multiplication curves show that as the system approaches criticality, source, counter, and geometry effects become relatively small near delayed criticality and good estimates of criticality are possible by extrapolation of the curves. Conditions known to result in anomalous multiplication leading to poor (unsafe) extrapolations of criticality are pointed out. The absolute measurement of neutron multiplication appears to be straightforward only in the case of some small fast-neutron metal assemblies. Particularly in the case of hydrogen-moderated systems that are subcritical by more than a few dollars, modal effects, source detector locations and geometry effects become difficult to interpret and a precise measurement of reactivity from neutron multiplication during an approach-to-criticality experiment under these circumstnces may not be possible. Concern is raised regarding the meaning and interpretation of k/sub eff/ as might be measured in a far subcritical system because of the modal effects and spectrum differences that exist between the subcritical and critical systems. Because of this, the calculation of k/sub eff/ identical to unity for a critical assembly, although necessary, may not be sufficient to assure safety margins in calculations pertaining to far subcritical systems.

1169 **(UCRL—92346) Improvements in the weldability of a superconductor sheath material.** Summers, L.T.; Morris, J.W. Jr. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 7 Aug 1985. Contract W-7405-ENG-48. 9p. (CONF-850814—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000748.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

This paper investigates the effects of chemistry and heat treatment variation on the 4-K tensile properties of A-286, a candidate sheath material for force-cooled superconductors. Currently, full use of A-286 and similar superalloys is limited by the observed low yield and ultimate tensile strengths in the welded and aged condition. The low strength is shown to be associated with the formation of precipitate-free zones as a result of alloying-element segregation during weld pool solidification. It has been determined that minor modifications of the weld-metal chemistry by the addition of Ti reduce precipitate-free-zone formation, resulting in matching weld-metal and base-plate strengths at 4 K. Furthermore, nucleation of the γ' hardening phase has been found to be a strong function of temperature and composition. Modified heat-treatment schedules have been determined that are amenable to superconductor fabrication and that resulted in increased weld hardening and improved 4-K tensile properties.

1170 **LAP joint resistance of Nb_3Sn cable terminations for the ICCS-HFTF 12 Tesla Coil program.** *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **19**: No. 3, 378-381(May 1983).

Lap joint resistance as a function of current and magnetic field has been measured across 12 Tesla Coil conductor cable termi-

nations. The terminations were at the ends of a 2.2 m Nb_3Sn hairpin of internally cooled and cabled superconductor (ICCS), and were soft soldered to NbTi bus bars. The resulting lap joints were each 15 cm long with a contact area of 19.8 cm^2. The maximum measured lap joint voltage drop was 75 μV at 21 kA and 4.2 K, with the cable center at zero magnetic field. This represents an upper bound on all measured voltage drops, including those with the cable center at 10 and 12 T, and corresponds to a maximum heat flux of 0.01 w/ cm^2 to pool boiling helium. The results imply that the 12 Tesla Coil, with four lap joints, would dissipate less than 7 watts in the steady-state at 21 kA. The zero field results and results at cross fields of 10 and 12 T are discussed. Manufacturing and experimental parameters relevant to this study are also considered.

4203 Lasers

REFER ALSO TO CITATION(S) 1238

1171 **(PPPL—2274) Measurement of population inversions and gain in carbon fiber plasmas.** Milchberg, H.; Skinner, C.H.; Suckewer, S.; Voorhees, D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1985. Contract AC02-76CH03073. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002532.

A CO_2 laser (~0.5 kJ energy, 70 nsec pulse width) was focussed onto the end of an axially oriented, thick (35 to 350 μ) carbon fiber with or without a magnetic field present along the laser-fiber axis. We present evidence for axial-to-transverse enhancement of the CVI 182A ($n = 3 \rightarrow 2$) transition, which is correlated with the appearance of a population inversion between levels $n = 3$ and 2. For the $B = 0$ kG, zero field case, the maximum gain-length product of $kl \cong 3$ ($k \cong 6\ cm^{-1}$) was measured for a carbon fiber coated with a thin layer of aluminum (for additional radiation cooling). The results are interpreted in terms of fast recombination due mostly to thermal conduction from the plasma to the cold fiber core.

1172 **(SAND—85-0225C) Calculated transient two-dimensional Marangoni flow in a pulsed-laser weld pool.** Russo, A.J. (Sandia National Labs., Albuquerque, NM (USA)). 18 Apr 1985. Contract AC04-76DP00789. 23p. (CONF-851125—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010671.

From American Society of Mechanical Engineers winter annual meeting; Miami, FL, USA (17 Nov 1985).

Pulsed-laser welding produces short-lived weld pools which have strong radial temperature gradients at the pool surface. These gradients produce surface tension variations which usually reinforce the weak natural convective flows caused by radial temperature gradients. The flow in the molten pool is of interest because it can change the temperature distribution in and around the molten zone which can alter the weld shape, and because it controls the transport of surface contaminants (or alloying or doping materials in case of surface processing) into the substrate. A two-dimensional finite difference code is being developed to model the transient flow in a prescribed axisymmetric weld pool geometry. A flux corrected transport algorithm is used with a vorticity-steamfunction formulation of the problem to calculate the flow field. Flow velocities during a typical laser pulse are presented for nickel and steel.

1173 **(UCRL—50025-85-2) Distributed computer control system in the Nova Laser Fusion Test Facility.** (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001303.

The EE Technical Review has two purposes - to inform readers of various activities within the Electronics Engineering Department and to promote the exchange of ideas. The articles, by design, are brief summaries of EE work. The articles included in this report are as follows: Overview - Nova Control System; Centralized Computer-Based Controls for the Nova Laser Facility; Nova Pulse-Power Control System; Nova Laser Alignment Control System; Nova Beam Diagnostic System; Nova Target-Diagnostics Control System; and Nova Shot Scheduler. The 7 papers are individually abstracted.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 72, 546, 1172, 1262

1174 **(AD-A—155259/5/XAB) Investigation into the fluidization and heat transfer of low-density particles in a fluidized bed with applications. Final report.** Modlin, J.M. (Army Military Personnel Center, Alexandria, VA (USA)). 10 May 1985. 184p. NTIS, PC A09/MF A01.

The lack of reliable data on the fluidization and heat-transfer characteristics of low density particles in a fluidized bed has prompted an experimental and analytical investigation into this subject. Seven groups of particles ranging in diameter from 0.25 to 2.0 mm and density from 2.5 to 32 pcf have been successfully fluidized and shown to be generally well predicted by classical fluidization and fluidized-bed heat-transfer theory. Two other groups of particles, also in this approximate range of particle diameter and density, are, however, unable to be fluidized due to significant inter-particle and static electric attractions. Using the experimental data and results as a basis of analysis, two application of low-density particle fluidization in a building efficient energy-management program are discussed. A fluidized bed can be incorporated into the wall cavity of a building for use as either a collector of solar energy or as a heat exchange medium in a building space heating/cooling program. As a solar collector, it is shown that the low density particle fluidized bed would thermally perform between comparable conventional liquid and air-cooled flat-plate solar collectors. It would require less water pumping power and plumbing than the liquid collector and less air pumping power than the air collector.

1175 **(AD-A—954717/5/XAB) Disabled personnel emergency-heating system. Final report.** Van Dine, N. (Energy Systems Corp., Nashua, NH (USA)). 16 Dec 1974. 4p. NTIS, PC A02/MF A01.

This progress report describes a receiving well for the operating fuel supply (two provided) designed within the unit to permit parasitic heat loss from the system to be captured by the fuel supply. The Zero can housing provides adequate volume to accommodate stowage of the fluid-flow umbilicals for connection of the heater system to the tubulated casualty bag liner.

1176 **(CONF-8504180—1) Acoustic detection of cavitation in a prototype centrifugal pump.** Cha, Y.S. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018447.

From International symposium on propeller and cavitation; Wuxi, Jiangsu, China (1 Apr 1985).

This paper describes the results of acoustic detection, using a submerged hydrophone, of cavitation in a prototype centrifugal pump. The experimental results show that the high-frequency (>10 kHz) noise provides a better means of detecting light and moderate pump cavitation conditions as compared with low-frequency cavitation noise that was not easily distinguished from the background noise. Another important observation was that cavitation noise started to increase sharply when the NPSH value was reduced to some critical value which seemed to coincide with the point where the head started to decrease for all the tests. Noise at higher frequency bands exhibited quite different behavior from that at low frequencies. For a high NPSH value, the high-frequency noise amplitude increased slightly as the NPSH value was decreased while the head remained constant. The high-frequency noise started to increase sharply as soon as the head began to decrease until somewhere near the 3% headdrop point. The noise level then decreased and increased again over a very narrow band of NPSH value. This phenomenon was observed in some other pump tests reported in the literature. A qualitatitve interpretation was provided to explain this behavior.

1177 **(DOE/ER/13164—T3) Convection heat transfer in the critical region of fluid mixtures. Progress report, October 1984-September 1985.** Marschall, E. (California Univ., Santa Barbara (USA). Dept. of Mechanical and Environmental Engineering). Sep 1985. Contract AS03-84ER13164. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000315.

This progress report covers work done on an experimental apparatus for measuring heat fluxes in the critical region of freon mixtures was perfected and experiments were carried out. A discussion of experimental setup, experimental procedure, and results obtained is attached. This discussion will be presented at the Third Symposium on Energy Engineering Sciences.

1178 **(INIS-BR—293) Determination of transfer parameters in corrugated plates exchangers.** Silva Lima Filho, S. da. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. Tecnologico de Aeronautica). 1984. 98p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86780037.

In this work is presented a experimental study about the forced convenction problem in vee-corrugated exchangers, with flow in the transversal sense, and parallel plates exchangers in which the isotermal plate is equivalent to the absobing one and the other plate is adiabatic. Global values of the transfer coefficients were experimentally obtained by application of the Naphthalene Sublimation Technique in accordance with the analogy between heat and mass transfer. The results were expressed in terms of Sh sup(-) /Sc sup(0,4) that according to the analogy is equal the Nu sup(-) / Pr sup(0,4) in function of the Reynolds number. The ratio between the lenght of the channel and the average spacing between plates L/2a was ranged in all the exchangers. Parameters of transfer to angles of 45° and 31° were determined in the corrugated plates exchangers. The experimental results obtained were analyzed and compared among them. Finally practical applications of these results are presented to heat exchangers with similars geometric characteristics. (Author).

1179 (INIS-mf—9910-Vol.2, pp 15-40) **Critical review of analytical correlations for two-phase flow regime transitions.** Bonalumi, R.A.; Yang, J.H.; Andrews, D.G. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Two sets of analytical correlations describing transitions between two-phase flow regimes are reviewed and discussed. One, the T-D set, is based on mechanistic models; the other, the Weisman set, on experimental correlations. The T-D set is preferred for horizontal flow, whereas the Weisman set seems preferrable for vertical flow. A computer code (FLOP) based on the T-D theory is described and applied to validate the theory.

1180 (INIS-mf—9910-Vol.2, pp 92-128) **Approximation of state functions of light water and heavy water in liquid, saturated and vapor states by linear functions in the region of 1000 to 12,000 kPa.** Kacimi, M. (Universite des Sciences et de la Technologie Houari Boumedienne d'Alger (Algeria)); Paskievici, W. (Ecole Polytechnique, Montreal, Quebec (Canada). Inst. de Genie Nucleaire). 1983. (In French). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

This paper presents the principal results of a study whose aim is to approximate all the relative thermodynamic parameters of heavy and light water by the linear or linearizable mathematical functions in the five possible thermodynamic states and in the pressure range of 1000 to 12,000 kPa. A second objective is the implementation of an information tool which permits the utilization of the results thus obtained to determine the state of the fluid under consideration as well as the values of all the thermodynamic parameters and their derivatives by means of the initial knowledge of the pressure, P, and enthalpy, H.

1181 **(ORNL/SUB—79-42539/2) Heat transfer characteristics of a structural lightweight concrete wall. Final report.** Van Geem, M.G.; Fiorato, A.E. (Construction Technology Labs., Skokie, IL (USA)). Jun 1983. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001471.

Tests were conducted to evaluate thermal performance of three concrete walls. A normal-weight concrete wall, a structural lightweight concrete wall, and a low density concrete wall were tested in the calibrated hot box facility of Construction Technology Laboratories, a division of the Portland Cement Association. This report covers experimental results for the structural lightweight concrete wall. Test results for the normal-weight concrete wall and low density concrete wall are covered in separate reports. The wall was subjected to steady-state, transient, and periodically varying temperature conditions in a calibrated hot box. Steady-state tests were used to define heat transmission coefficients. Data obtained during transient and periodic temperature variations were used to define dynamic thermal response of the wall. Thus, effects of heat storage capacity could be evaluated. Conductivities derived from calibrated hot box tests were compared with results from hot wire tests. Hot wire tests were also used to evaluate the influence of moisture on thermal conductivity. Data obtained from dynamic tests were compared with steady-state calculations. Data obtained in this investigation are applicable to concrete wall assemblies commonly used in multi-family residential, commercial, and industrial structures. Results provide a data base for evaluation of building envelope performance in such structures, and are also applicable for defining thermal characteristics of concrete walls in passive solar systems. 21 refs., 33 figs., 19 tabs.

1182 **Heat transfer in large particle fluidized beds.** Decker, N.; Glicksman, L.R. (Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA). *International Journal of Heat and Mass Transfer;* **26**: No. 9, 1307-1320(Sep 1983).

A physically based model is proposed for heat transfer to immersed surfaces in large particle fluidized beds. 'Large' particles are distinguished as those with thermal time constants substantially greater than their residence time at a heat transfer surface. At typical fluidized bed combustor operating conditions, particles 1 mm or larger are 'large'. Conduction through the gas near points of solid contact and convection by the interstitial gas flow both contribute to heat transfer during emulsion (or dense phase) contact. As particle size increases the heat transfer by gas convection provides a greater share of the heat transfer. It is shown that the gas convective component in fluidized bed heat transfer is not simply related to overall gas convection in a packed or quiescently fluidized bed. The model is shown to provide good agreement with data from several sources.

4205 Materials Testing

REFER ALSO TO CITATION(S) 258, 489, 1027

1183 **(CEA-CONF—7672) Foucault current testing of ferritic steel fuel cans.** Stossel, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). Oct 1984. 10p. (In French). (CONF-8410204—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752883.

From 3. European conference on nondestructive testing; Florence, Italy (15 Oct 1984).

The analysis of impedance involved by a Foucault current test of ferritic steel tubes, is quite different from the classical analysis which refers to non-magnetic tubes; more particularly, volume defects are considered as magnetic anomalies. Contrarily to current instructions which recommend to test the product in a satured magnetic state, it is very interesting to work with a continuous energizing field, comparatively low, corresponding to a sequenced magnetization, of which value is obtained according to the magnetic

structure of the product. This analysis is useful when testing fast reactor fuel cans.

1184 **(CEA-CONF—7675) Focused ultrasonic wave testing, in immersion of spent fuel cans.** Poinboeuf, P.; Furlan, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). Oct 1984. 19p. (In French). (CONF-8410204—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752891.

From 3. European conference on nondestructive testing; Florence, Italy (15 Oct 1984).

To detect weak and very weak damage of the fuel can, ultrasonic testing has been used. For that, a simple mechanical device, allowing to maintain an optimal ultrasonic focussing on irradiated cans, is presented. Its aim is to correct the variation of the incidence angle due to the possible ovalization of pins. After a description of the device, the results obtained with tests carried out on non-irradiated cans, including artificial ovalized regions, standard defects, are presented. After the description of the adaptation of this mechanism on a test bench which allows an helicoidal exploration of pins, some results obtained in hot cell during examinations experimental pins and previously tested by Foucault current.

1185 **(INIS-BR—290) Analysis of residual stresses in welded joints.** de Lemos, F.L. (Minas Gerais Univ., Belo Horizonte (Brazil). Escola de Engenharia). 1984. 75p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780020.

The study of two stress measurements techniques is presented showing experimental results that allows to evaluate its reliability. These two methods are The Center Hole Drilling Method and The Overcoring and they are considered semi-destructive methods. (E.G.).

1186 **(INIS-mf—9905) Nondestructive testing '83.** (Ceska Vedeckotechnicka Spolecnost, Prague (Czechoslovakia). Dum Techniky). 1983. 69p. (In Czech). (CONF-8310399—). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091.

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

The seminar proceedings contain 21 papers. Seven papers were input into INIS. Topics covered include: applications of X-ray/TV imaging for quality control of welded joints and crack detection of castings; computer codes for calculating exposure times in ^{60}Co gamma radiography of structures and materials; specifications of sealed sources for materials testing; thermal neutron radiography; ultrasonic testing of reactor pressure vessels; organizing and testing aids for welding and surfacing jobs in nuclear power plants.

1187 (INIS-mf—9905, pp 9-19) **Experience with X-ray/TV imaging method.** Smrcka, M. (CKD Praha (Czechoslovakia)); Wisinger, R. (CKD, Kutna Hora (Czechoslovakia)). 1983. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091. (CONF-8310399—).

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

The control of internal quality of welded joints of pressure vessels is designed using the X-ray/TV imaging method. The application is assumed of X-ray instrument Isovolt by Seifert, X-ray/TV imaging system RBV 17 (Seifert) or the developed Czechoslovak equipment, and complementary recording instrument (Seifert). Testing was carried out on standards with artificial defects, with butt welds and wire gauges. The possibilities of the method were tested, and Czechoslovak and peak foreign equipment compared.

1188 (INIS-mf—9905, pp 20-30) **Application of X-ray/TV chain in testing steel castings in Ceske Budejovice SKODA plant.** Spika, L. (Skoda, Ceske Budejovice (Czechoslovakia)). 1983. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091. (CONF-8310399—).

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

The results are presented of the test operation of an X-ray/TV system whose introduction into crack detection increased the number of tested castings and brought significant savings.

1189 (INIS-mf—9905, pp 31-34) **Program for calculating exposure times in ^{60}Co gamma radiography of structures and materials.** Svoboda, R. (Vysoke Uceni Technicke, Brno (Czechoslovakia)). 1983. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091. (CONF-8310399—).

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

The problem is discussed of the determination of exposure time for the instantaneous activity of a ^{60}Co source and the optimal distribution of film darkening in relation to the changing thickness of the radiographed construction and the changing focal distance. The exposure time is influenced by the properties of the used X-ray film. Exposure rate at the place of the film is influenced by geometry and by the properties of the radiographed materials and the used gamma radiation source. The relations are given for exposure rate, exposure time for a given darkening, and the darkening achieved for a given exposure time. A program was developed for computation of the exposure time with the HP-65 pocket calculator.

1190 (INIS-mf—9905, pp 47-53) **Thermal neutron radiography.** Bizek, V.; Zavadil, Z. (Statni Vyzkumny Ustav Materialu, Prague (Czechoslovakia)). 1983. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780091. (CONF-8310399—).

From 18. national seminar on nondestructive testing; Jihlava, Czechoslovakia (18 Oct 1983).

The content is presented of American standard E 748-80 on neutron radiography whose method is defined. Neutron sources are dealt with as are methods of neutron detection and further requirements on technical equipment. Basic applications of neutron radiography are given.

1191 **(Juel—1962) Programming system for a modular, flexible multicomputer system for the automatic control of automated test equipment.** Schmidt, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentrallabor fuer Elektronik; Technische Hochschule Aachen (Germany, F.R.)). Nov 1984. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85752124.

The hardware used is operationally directed, consisting of largely self-functioning, micro-computing modules, combined together over a parallel systembus. For communication purposes between the modules and the synchronize their activities a multi microcomputing operating system is being developed which corresponds to the specific demands of computerized process-control (handling of real-word events under real-time conditions and operation of several parallel-running subprocesses). In order to program the user-specific test cycles a programming language has to be made available which can be coordinated with the operational range of specific test equipment in terms of commands and syntax and which can also easily be learned by operators having no specialised knowledge of data processing. With this objective in mind, a structural system is developed in this work, by the aid of which application-oriented programming languages can be implemented. The adaption of the programming system to a wide spectrum of applications in automatic testing is facilitated by its modular structure. The efficiency of the system is demonstrated by meeans of an industrial pilot-scale implementation.

1192 **(SAND—85-0486) Numerical and experimental study of the indentation hardness test.** Bourcier, R.J.; Stone, C.M.; Yost, F.G. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002095.

The process of indentation hardness testing has been analyzed both experimentally and numerically. A set of indentation experiments has been performed for several materials with conical/pyramidal and spherical indenters. The large strain elastoplastic finite element program JAC has been used, with tensile stress-strain data as input, to model these tests as well as tests reported in the literature. Load-depth curves generated with our finite element model deviate less than 15% from experimental data (both our own as well as literature values) for both large scale (up to 250 μm

depth) and small scale (less than 5 μm depth) indentation tests for all indenter geometries examined. Also, agreement between the model and micro-micro (less than 1 μm) pyramid indentation data from the literature is quite good. These results suggest that load-depth response of indentation hardness tests can be successfully predicted with a continuum based finite element model. In addition, examination of the finite element results has suggested several corrections based on geometry which must be included when computing the hardness of near surface material.

1193 **(SAND—85-2009) Projectile and impactor designs for plate-impact experiments.** Asay, J.R.; Chhabildas, L.C.; Barker, L.M. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1985. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001680.

The use of plate-impact techniques for producing a variety of loading histories in plane wave experiments is discussed. Specific techniques concern direct shock compression, shock compression followed by unloading, shock compression followed by further loading, shock compression followed by unloading and then reloading (cyclic loading), shockless compression (quasi-isentropic loading), and pressure-shear loading. Emphasis is placed on the considerations of projectile and impactor design and the constraints of structural loading during projectile acceleration, which are associated with these loading conditions.

1194 **(SRD-R—224) Slow stable crack growth: a structural effect.** Quirk, A. (UKAEA Safety and Reliability Directorate, Culcheth). May 1983. 61p. United Kingdom Atomic Energy Authority, Wigshaw Lane, Culcheth Warrington WA3-4NE. File Number TI85901933.

Several methods for evaluating the fracture toughness of ductile material rely on the observation, that slow stable crack growth under rising load occurs in the test specimen before the crack starts to propagate under decreasing load. The measurement of this slow stable crack extension then gives a value for the fracture resistance of the material. Here, it is suggested that slow stable crack growth is purely a structural effect, in that the test piece deformation causes bending stresses that reduce the direct load induced stresses in the crack tip region. This suggestion is supported by strain gauge data obtained from several flat plates and vessel tests.

1195 **The effect of reactive gases on oxygen sensor responses.** Federer, J.I. (Oak Ridge National Laboratory, Oak Ridge, TN). *Journal of the Electrochemical Society;* **131**: No. 4, 755-760(Apr 1984).

Ceramic electrolyte oxygen sensors consisting of stabilized zirconia with platinum electrodes were compared in flowing gases in a laboratory apparatus. The oxygen partial pressures indicated by these sensors i reactive gases were substantially different. Gases containing CO produced a greater difference than gases containing H_2. The responses of these sensors were attributed to their relative catalytic behavior.

1196 **(CE-Trans—7585) Selection of parameters in numerical ultrasonic holography.** Kutzner, J.; Zimpfer, J.; Wustenberg, H. (Central Electricity Generating Board, London (UK). Information Services). [1985]. Translation source information not available . (CONF-780436—2). 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86900135.

From Lecture meeting and exhibition on non-destructive materials testing; Mainz, F.R. Germany (24 Apr 1978).

The successful application of acoustic line holography in the field of inspection means that the best possible use must be made of the parameters governed by physical laws that are involved in the quality of the image. A sensible approach is therefore in the first place to look more closely at the resolution of the holographic reconstruction, in order in this way to obtain information both for the optimum selection of the probe systems and also for the optimum establishment of the other inspection parameters, e.g., the number of sampling points and aperture size. It is important to note that it is only possible to arrive at a compromise, since the two requirements - on the one hand resolution that is as high as possible, and on the other hand an acceptable outlay for computer capacity - conflict with one another. Using these notions as a starting point, experimentally verified criteria are given for the selection of parameters.

1197 **(CE-Trans—7584) Experience with the utilization of ultrasonic holography with numerical and optical reconstruction.** Schmitz, V.; Wosnitza, M. (Central Electricity Generating Board, London (UK). Information Services). [1985]. Translation source information not available . (CONF-780436—3). 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86900139.

From Lecture meeting and exhibition on non-destructive materials testing; Mainz, F.R. Germany (24 Apr 1978).

The experiments presented, with optical and numerical reconstruction, show that ultrasonic holography is able to make a contribution to the analysis of defects in the field of nondestructive testing. Both methods of reconstruction have advantages and disadvantages. Optical reconstruction has the advantage of permitting the processing of parallel data in a few ns with low equipment costs. The advantages of numerical reconstruction lie in the free choice of the reconstructing wavelength, the possibility of using signal processing methods, and in the fact that the process can be automated. Through the utilization of the latest electronics, such as array-processors, the problems in the processing of large quantities of data can be more readily overcome. The computation times can be shortened by a factor of 100, and this would mean the attainment of another stage along the way to real-time processing.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 456, 1935

4207 Vacuum Engineering

1198 **(GEPP-OP—674) Internal motion in high vacuum systems.** Frank, J.M.; Ney, R.J. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 6 Oct 1982. Contract AC04-76DP00656. 16p. (CONF-821111—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001646.

From 29. national symposium of American Vacuum Society; Baltimore, MD, USA (16 Nov 1982).

Three transfer and positioning mechanisms have been developed for the non-air exposed, multi-step processing of components in vacuum chambers. The functions to be performed in all of the systems include ultraviolet/ozone cleaning, vacuum baking, deposition of thin films, and thermocompression sealing of the enclosures. Precise positioning of the components is required during the evaporation and sealing processes. The three methods of transporting and positioning the components were developed to accommodate the design criteria and goals of each individual system. Considerations affecting design included cost, contamination control, level of vacuum, material throughput, ease of operation, maintenance requirements and serviceability.

4208 Electronic Circuits And Devices

1199 **(CEA-LETI-RA—1983) 1983 Annual progress report. [Laboratoire d'Electronique et de Technologie de l'Informatique].** (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). May 1984. 134p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE85752843.

This report is concerned with the whole activities of the LETI (Laboratoire d'Electronique et de Technologie de l'Informatique) during 1983. They defined three sections which are "materials", "electronic components" and the one called "instrumentation and systems". Among the magnetic materials, materials for magnetic bubble memories are considered. Among semi-conductor materials, first, crystals of gallium arsenide and germanium are peculiarly studied; then researches on crystal growth processes aim at deposition of zinc or cadmium sulfide thin layers in aqueous solutions; and, finally, piezoelectric material researches consisted essentially in developing fabrication processes of lithium niobiate. Mate-

rials for infra-red devices are also studied together with materials related to optical microstructures (LNA, MgF_2, $LiYF_4$). The section "Components" comprises silicium microelectronics (ionic implantation techniques, MOS systems, etc), the magnetic bubble memories, the components related to integrated circuits for infrared imaging or to Josephson effect devices. Display, sensors, optical telecommunications, wiring terminations are also concerned. Physics and medicine instrumentation (magnetometry, time-of-flight positron tomography, X-ray tomography, NMR spectrometry in-vivo), robotics and technology of acquisition and processing of images (in view of an automatic control) are activities of the last section.

1200 **(GEPP-OP—844) High reliability capacitors for nuclear weapon applications.** Packer, W.E. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 1985. Contract AC04-76DP00656. 6p. (CONF-8503184—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001648.

From CARTS '85; San Diego, CA, USA (11 Mar 1985).

The purpose of this work is to provide very high reliability capacitors for two basic nuclear weapon circuit applications. The first requirement is for a low inductance capacitor with high discharge current capability. The second application is a high voltage and precise capacitance unit for use in a pulse shaping network.

1201 **(KFK—3806) Matching problems in pulse power radial transmission lines.** Mittag, K.; Brandelik, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1984. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85752213.

In this report we study the power transfer from a generator along a coaxial transmission line followed by a radial transmission line into a load, which in our application is a pseudo-spark plasma of about one millimeter diameter and about 15 cm in length. First the theoretical background based on transmission line theory is described. Then numerical results are presented. The main conclusion is that when matching the pulse power generator to the pseudo-spark plasma, the effect of the impedance transformation caused by the radial transmission line has to be taken into account. The conditions to obtain an optimal match are described.

1202 **(LBL-PUB—3037) Junction-capacitance transient spectroscopy.** Pearton, S.J. (Lawrence Berkeley Lab., CA (USA)). Nov 1983. Contract AC03-76SF00098. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86000627.

This document serves as an introduction to the various forms of space-charge spectroscopy of deep levels in semiconductor junctions and contains operating instructions for the present DLTS system.

1203 **(NUREG/CR—2045) Power regulator for direct heating of material with inverse resistance-temperature properties.** Rush, K.; Rochelle, J.M.; Kelly, M.J. (Oak Ridge National Lab., TN (USA)). Jun 1981. Contract AC05-84OR21400. 29p. (ORNL/NUREG/TM—450). NTIS, PC A03/MF A01 - GPO. File Number TI86000906.

An ac power regulator was designed for loads with inverse resistance-temperature properties. It is equipped with an integrated-circuit, analog multiplier for power computation. Its output power accuracy, achieved by automatic zero correction of the multiplier drift, is +-1% full scale over a range from 0 to 4 kW. Power is controlled by symmetrical phase firing of inverse-parallel SCRs; series inductance maintains loop stability when the load resistance is very low, reduces the current waveform crest factor, lowers the harmonic power content, inherently limits the load current, reduces the di/dt, and practically eliminates the rf noise often generated by phase-fired equipment. This report describes the design details for the current feedback, multiplier, error integrator, conduction angle control, and SCR firing circuits.

1204 **(SAND—85-0195) Chemical preparation of high-field zinc oxide varistors.** Dosch, R.G.; Kimball, K.M. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 97p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001611.

Chemical preparation methods were developed for high-field ZnO varistors in which precipitation techniques were used to prepare precursor powders. Varistors were made by sintering uniaxially pressed pellets in the range of 675 to 740°C in air. Varistor properties included electric fields(E) in the 10 to 100 kV/cm range at current densities(J) of 5A/cm², nonlinearity coefficients(α) greater than 30 at $2.5 \leq J \leq 5.0$ A/cm², and densities in the range of 65 to 99% of theoretical depending both on sintering temperature and composition.

1205 **(SAND—85-1484C) System design methodology for use in design of large-scale systems.** Branscombe, D.A.; Wisniewski, J.A.; Righter, A.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 4p. (CONF-851161—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85014463.

From GOMAC conference; Orlando, FL, USA (5 Nov 1985).

The authors have investigated a system design methodology enabling multilevel design and simulation. Thid methodology involves adding a step to the currently used approach: a behavioral language model (BLM) description of a system or circuit written in the computer programming language Pascal. This BLM complements and enhances gate-level design, gives another means of communication to both system-level and design personnel, and can be compared with gate-level circuit descriptions during simulation for verification purposes. In addition to these advantages, the BLM description results in tremendous improvement in simulation computer time over gate-level circuit descriptions. The purpose of this study is to demonstrate the feasibility and benefits of applying this system design methodology to the development of most systems. The Trident II Arming Fusing & Firing (AF & F) RADAR interface was selected as an example system due to its feasibility of expression in hierarchical fashion and its complex data transmission requirements.

1206 **(UCID—20542) HEMP internal coupling phenomenology study.** Kunz, K.S.; Hudson, H.G.; Breakall, J.K.; King, R.J.; Ziolkowski, R.; Madsen, N.; Peterson, J.; Pennock, S.T. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001439.

This report documents a task sponsored by DNA to unravel the electromagnetic coupling problem associated with the interaction of the high altitude electromagnetic pulse HEMP) with typical aerospace systems. A bottom up approach to this task has been selected. In this approach, tools are developed for measuring and predicting the responses of simple test systems; from these measurements and predictions phenomenological understanding of the coupling mechanisms may be obtained and the tools may be verified. The construction and the experimental characterization of a test system embodying the fundamental features of an interior coupling problem, is discussed. Experimental, computational and analytical tools has been applied to this test system. Experimental measurements have revealed a pronounced modal interior response which has been closely replicated with the time domain three dimensional finite difference code G3DXL3. The persistence of these modes has been established analytically with an N-series analysis. Focusing and reflection effects as well as hot spot formation have been examined with the N-series analysis and with a time domain two-dimensional finite element code GEM2D.

1207 **Direct gating of microchannel plates.** Jacoby, B.A.; Kotecki, D.E.; Lear, R.D. (Lawrence Livermore National Laboratory, Livermore, CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-30: No. 6, 4624-4627(Dec 1983).

The authors have investigated whether direct fast gating of microchannel plates (MCP) is possible. Their experiments measured the MCP gain as a function of time (on the nanosecond time scale) for an MCP intensifier tube that was gated by applying voltage to the plate itself. They also examined the dynamic range of an MCP that was being gated. Our results showed that, though an MCP takes milliseconds to recharge, fast gating is not incompatible with this slow recharge time.

4209 Waste Processing Plants And Equipment

1208 **(DOE/R1/21263—T1) Non-polluting, energy-efficient garbage disposal method.** Breton, J.R. (BRR Corp., New London, CT (USA)). [1985]. Contract FG41-81R121263. 30p. NTIS, PC A03. File Number DE86000507.

This study has examined the possibilities of a novel method of handling garbage, namely incinerating it in an enclosed chamber in an atmosphere of pure oxygen. The design has shown itself robust and flexible with abundant latitude for accommodating user's requirements. The concept does not require great size, so that the proposed design might find a ready market for schools, commercial establishments, apartment complexes, etc. Even groups of individual residences might benefit. The system may be configured as an auxiliary source of heat. In this configuration the design offers, in addition to eliminating the garbage problem, the extra advantage of approximately halving heating costs. In another configuration the system may become the source of hydrogen, a high energy fuel with commercial possibilities of its own. The study has only considered design requirements. To proceed further to a useful device, there must follow engineering development and economic feasibility. 3 figs.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 264, 288, 823, 824, 846, 847, 848, 849, 1182

1209 **(DOE/R1/10046—T1) Wood burning rock storage furnace design, construction and operation. Final report, August 1979-September 1980.** (Community School at Packard Manse, Stoughton, MA (USA)). 15 Oct 1980. Contract FG41-79R110046. 35p. (MA—79-002). NTIS, PC A03. File Number DE86000388.

The design and construction of a rock storage wood-burning furnace for use with an air-to-air solar system are described. Steel framed rock bins were used. The storage bin was modified to allow a space for the combustion chamber. Stones were placed to maintain void spaces throughout. Provisions were made for access to all parts of the flue pipe and for a circulating fan blade within the storage chamber. The walls were insulated with 5 in. of high temperature insulating material. The outside was plastered with perlited gypsum and plaster aggregate. Drawings are included. 7 figs. (DMC)

1210 **(PB—85-218808/XAB) Feasibility study of enhanced combustion via improved wood stove firebox design. Rept. for December 1984-March 1985.** Fuentes, K.T.; Hodas, L.J.; Osborne, M.C. (Radian Corp., Austin, TX (USA)). 1985. 36p. NTIS, PC A03/MF A01.

The paper gives results of an examination of materials that might be used within the firebox of a wood-burning stove to produce more uniform and complete combustion. Although many materials were initially considered, refractory materials appear to possess the qualities desired relative to heat transfer, resistance to the firebox environment, availability, and cost. Further investigation of specific refractory materials has been carried out, resulting in a listing of material properties of potentially useful refractories and a determination of relative installed costs. Basic heat-transfer calculations were used to determine the effects of the addition of refractory materials in the firebox. The use of refractory materials permitted an increase in stove inner-wall temperatures and an increased cooldown time for a stove. The study showed that refractory materials could aid in maintaining internal firebox temperatures above the ignition temperatures of common emissions. This would not be a practical operational mode for an uninsulated stove. The study concluded that there is a need for actual testing to confirm the results cited in this study.

1211 **(PNL—5563) Opportunities in pulse combustion.** Brenchley, D.L.; Bomelburg, H.J. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001436.

In most pulse combustors, the combustion occurs near the closed end of a tube where inlet valves operate in phase with the pressure amplitude variations. Thus, within the combustion zone, both the temperature and the pressure oscillate around a mean value. However, the development of practical applications of pulse combustion has been hampered because effective design requires the right combination of the combustor's dimensions, valve characteristics, fuel/oxidizer combination, and flow pattern. Pulse combustion has several additional advantages for energy conversion efficiency, including high combustion and thermal efficiency, high combustion intensity, and high convective heat transfer rates. Also, pulse combustion can be self-aspirating, generating a pressure boost without using a blower. This allows the use of a compact heat exchanger that may include a condensing section and may obviate the need for a chimney. In the last decade, these features have revived interest in pulse combustion research and development, which has resulted in the development of a pulse combustion air heater by Lennox, and a pulse combustion hydronic unit by Hydrotherm, Inc. To appraise this potential for energy savings, a systematic study was conducted of the many past and present attempts to use pulse combustion for practical purposes. The authors recommended areas where pulse combustion technology could possibly be applied in the future and identified areas in which additional R and D would be necessary. Many of the results of the study project derived from a special workshop on pulse combustion. This document highlights the main points of the study report, with particular emphasis on pulse combustion application in chemical engineering.

1212 **Development and testing of a furnace with a low temperature plastic condensing heat exchanger.** Wright, J.; Briggs, J.; Sullivan, H.F.; Hayden, A.C.S. (National Research Council of Canada). pp 922-929 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The prototype furnaces completed during this project have proved the recirculation loop concept. This design allows low temperature plastics to be used as a condensing heat exchanger construction material. The recirculation loop is capable of cooling the flue gas to below 95°C (as designed). Coroplast appears to be well suited to this application. There was no evidence of degradation in any of the plastics tests or as a result of furnace operation. The prototype furnaces have a steady state efficiency of 92%. The thermal performance of the furnaces is in good agreement with predicted results.

1213 **Decoupler design guidelines for improving sound levels and stability of pulse burners.** Vishwanath, P.S. (American Gas Assoc. Lab.). pp 912-921 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The design of decouplers has significant impact on inlet and exhaust sound emissions and overall burner stability. Extensive tests on several hundred burner/decoupler combinations have shown that by following the design guidelines given above, the sound emissions can be appreciably reduced without losing burner stability. As such, these guidelines have proved to be an excellent means to systematically size inlet and exhaust decouplers in our developmental projects. All the tests for developing these guidelines were done using cylindrical burner and decoupler components. Limited tests done with non-cylindrical components have shown these guidelines to be valid in those cases also. Additional work needs to be performed to refine these guidelines into exact design correlations valid for different burner and decoupler geometries.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 114

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 51

1214 **(K/PS—5061) Vapor-aerosol physicochemical laboratory.** Lore, J.D.; Skeen, L.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1 Oct 1985. Contract AC05-84OT21400. 12p. (CONF-8510151—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000522.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A laboratory capable of generating and characterizing vapors and aerosols at typical ambient concentration levels observed in chemical processing operations has been established at the ORGD Plant, operated by Martin Marietta Energy Systems, Inc. for the USDOE. A three-stage generation system (TSGS), originally developed by SRI, International, for the analytical methods validation studies sponsored by NIOSH, has been installed. Several aerosol/particulate monitors, controlled by microcomputers, provide the means for semi-real-time particle size and mass concentration measurements over the size range 0.1 to 10 μm. A full complement of chemical analysis instrumentation including laser Raman spectroscopy and gas chromatography-mass spectrometry is available for in-situ or sequential measurements of TSGS diluents. 2 refs., 7 figs., 2 tabs.

4250 Power Cycles

1215 **(ORNL/SUB—80-61618/1) Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program. Phase I/IA. Final report.** (Mechanical Technology, Inc., Latham, NY (USA)). Jun 1985. Contract AC05-84OR21400. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86001463.

This report presents the results of an effort to develop and demonstrate the technical feasibility of a residential size Stirling engine driven, diaphragm coupled compressor for a heat pump application. The module was to consist of a free piston resonant engine capable of producing 3 kW of useable power, a low loss hydraulic transmission and a nominal 3 ton refrigerant-22 reciprocating compressor. Presented are details of analysis predicted performance goals, design, development of hardware, component testing, and engine/compressor breadboard testing. The test results demonstrated the mechanical feasibility and operational stability of the design concept. The assembly did not stroke out to achieve the full capacity levels predicted, however, and a follow on phase IA was initiated in which the reasons for the short fall will be determined. Details of phase IA are included in the appendix. In general, it was concluded that losses in the hydraulic transmission were excessive to the point where insufficient power was available to the compressor to satisfy its driving requirements at the design point conditions. Future work is recommended to reduce the transmission losses so that full capacity can be achieved. 69 figs., 47 tabs.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 1794

1216 **(BNL—36935) Cold iron cos Θ magnet option for the SSC.** Reardon, P. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-850504—287). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001175.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

We review first the evolution over the past several years of a cold iron, high field cos Θ magnet design option for the SSC. We note the collaborative approach pursued by BNL and LBL on the 2-in-1 option, and the culmination of this effort in the tests of the BNL 4.5 m model magnets. Next, we discuss the subsequent 1-in-1 option being pursued jointly by BNL, Fermilab and LBL.

1217 **(BNL—37011) Performance of three 4.5 m dipoles for SSC reference design D.** Dahl, P.; Cottingham, J.; Fernow, R.; Garber, M.; Ghosh, A.; Goodzeit, C.; Greene, A.; Herrera, J.; Kahn, S.; Kelly, E. (Brookhaven National Lab., Upton, NY (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Lawrence Berkeley Lab., CA (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-850920—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001736.

From 9. international conference on magnet technology; Zurich, Switzerland (9 Sep 1985).

Three 4.5 m long dipoles for Reference Design D of the proposed Superconducting Super Collider have been successfully tested. The magnets are cold-iron (and cold bore) 1-in-1 dipoles, wound with current density-graded high homogeneity NbTi cable in a two-layer cos θ coil of 40 mm inner diameter. The coil is prestressed by 15 mm wide stainless steel collars, and mounted in a circular, split iron yoke of 267 mm outer diameter, supported in a cylindrical yoke containment vessel. At 4.5 K the magnets reached a field of about 6.6T with little training, or the short sample limit of the conductor, and in subcooled (2.6 to 2.4 K) liquid, 8T was achieved. The allowed harmonics were close to the predicted values, and the unallowed harmonics small. The sextupole trim coil operated at eight times the required current without training.

1218 (INIS-mf—9910-Vol.1, pp 38-62) **Accelerator breeders, will they replace liquid metal fast breeders.** Grand, P.; Powell, J.R.; Steinberg, M.; Takahashi, H. (Brookhaven National Lab., Upton, NY (USA)). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Advances in accelerator technology make accelerator breeding of fissile fuel more and more attractive. Brookhaven studies indicate that accelerator breeders could be implemented commercially within twenty years and that the resulting AB-LWR fuel cycle cost is competitive with that of the LMFBR. This cost competitiveness would be greatly enhanced with more advanced converters. Feasibility studies carried out at Brookhaven over the last few years addressed principally the question of neutronics and engineering feasibility of the target system, technical issues of accelerator technology and cost/benefit analysis.

1219 (INIS-SU—302, pp 387-394) **Collective methods of acceleration.** Sarantsev, V.P. (Joint Institute for Nuclear Research, Dubna, USSR). 1983. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE85781610. (CONF-8210133—Vol.2).

From 8. All-Union conference on the charged particle accelerators; Protvino, USSR (19 Oct 1982).

A description of various methods of collective acceleration of ions is presented. Block diagrams of installations, realizing the methods, are considered. Intensive electron beam accelerators using the space charge field for ion acceleration; accelerators, where waves with the negative energy in the electron beam, propagating in vacuum, which is confined by a longitudinal magnetic field, are used to realize collective acceleration; electron ring accelerators and acceleratg:s with collective focusing have been studied. It is shown, that the use of collective accelerators in combination with other systems will considerably increase the efficiency of accelerator complexes. 10 referenes, 13 figures.

1220 **(LBL—19394) Superconducting materials for the SSC.** Scanlan, R.; Royet, J.; Taylor, C.E. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 13p. (CONF-850814—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000618.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

The proposed Superconducting Supercollider presents several new challenges with regard to materials for dipole magnets. One design requires a NbTi superconductor with J/sub c/ (5T) greater than 2400 A/mm^2, whereas the Tevatron recently completed at Fermilab required a J/sub c/ (5T) $\geq$ 1800 A/mm^2. In addition, the high field design requires a conductor with a filament diameter of about 2.5 μm, if correction coils are to be eliminated. Finally, the high field design utilizes a 30-strand cable which again is a significant increase from the 23-strand cable used in the Tevatron. This paper describes the results of recent R and D programs aimed at meeting the stringent material requirements for the SSC.

1221 **(SAND—85-2154C) Hermes III.** Hasti, D.E.; Ramirez, J.J.; Prestwich, K.R.; Sanford, T.W.L.; Hamil, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 13p. (CONF-8510165—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001622.

From 6. JOWOG meeting; Aldermaston, England (7 Oct 1985).

Hermes III is a major new gamma-ray simulator that is part of the Simulation Technology Laboratory Project. This accelerator will significantly improve the capability of Sandia National Laboratories and the Department of Energy to evaluate the effects of gamma-ray radiation from nuclear weapons on weapons subsystems. This accelerator will be designed to produce 10^5 R, 5 x 10^{12} R/S and 2 x 10^{20} R/S^2 over a 500 cm^2 area. The radiation dose will vary less than a factor of two over this area and less than a factor of four throughout a volume found by extending this surface 15 cm further from the gamma-ray converter. The minimum dose in this volume will be $\geq$5 x 10^4 R. The accelerator will be designed with sufficient reliability and short enough turn-around time to produce more than 600 radiation pulses per year. In Hermes III we are increasing the peak power in the beam from 1.2 TW of Hermes II to 16 TW. Two techniques for achieving these high powers have been successfully developed. The first technique is a high current linear induction accelerator with several parallel beams. Experiments to evaluate this concept were done on the MABE accelerator. The second concept uses induction cavities and a magnetically insulated transmission line (MITL) to form a multi-terawatt voltage adder. This report gives a detailed description of Hermes III and its components.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 1240

1222 **(BNL—37079) Polarized protons from the source to 70 GeV.** Makdisi, Y.I. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-8506173—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001184.

From Workshop on polarized beams at the SSC; Ann Arbor, MI, USA (10 Jun 1985).

This energy range covers the current project at the AGS and extends well beyond it. I shall report on our learning experience at BNL, discuss the potential for improvement, and the limitations of extending the AGS resonance jumping technique beyond 25 GeV.

1223 **(CONF-8508133—1) ORNL NPB tasks.** Crawford, O.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018066.

From NPB program technical interchange meeting; Huntsville, AL, USA (20 Aug 1985).

ORNL's work on optical target return radiation is funded by AFWL, in connection with discrimination. Observation of the optical emission (visible, ultraviolet or low-energy x-ray) due to NPB bombardment may be a way to determine readily how much (if any) beam is on the target. One needs to know the beam is on target in order to discriminate. Since optical photons originate from very near the surface, they can be emitted from light targets (pen-aids) as well as from heavy ones. Also, the ability to focus is an important advantage in connection with maximizing signal and minimizing noise. Accomplishments include theoretical predictions of intensity and spectral distribution of optical photons from neutral H atom bombardment. Many physical mechanisms have been considered in these predictions, which cover the spectral range from visible and ultraviolet light to low-energy x-rays. Luminescence (i.e., from electron-hole recombination) is predicted to be potentially the strongest source of optical emission. Research was also performed on laser photodetachment in a magnetic field, electrical breakdown phenomena, and calculations of dose distributions in targets exposed to high-energy radiation.

1224 **(LA-UR—85-2942) Summary from working group on noninterceptive diagnostics.** Chamberlin, D.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-8505164—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000790.

From Workshop on high brightness, high current, high duty factor ion injectors; San Diego, CA, USA (21 May 1985).

The working group for noninterceptive diagnostics spent much of its time comparing diagnostic techniques from different fields and their possible application to high-power injectors. The group included backgrounds from electron beam diagnostics, fusion power diagnostics, cw ion source and transport design, and ion beam of diagnostics. The probability of success for adapting techniques from these different areas is quite difficult to judge, short of a detailed examination of each application. Unexpected flaws or unforeseen noise sources can eliminate an idea that would otherwise appear promising. The report presents several ideas that were discussed, with an indication of those ideas most likely to succeed if implemented.

1225 **(LA-UR—85-3164) Electron-beam envelopes and matching for a combined wiggler and alternating-gradient quadrupole channel.** Wang, T.F.; Cooper, R.K. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 14p. (CONF-850956—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000783.

From 6. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

This work studies the electron-beam envelopes and matching for a combined wiggler and alternating-gradient quadrupole field for a free-electron laser (FEL) that will be operated in the VUV or XUV wavelength region. The quadrupole field is assumed to vary continuously along the symmetry axis. The linearized equations of electron motion are solved analytically by using the two-scale perturbation method for a plane polarized wiggler. The electron-beam envelopes and the envelope equations, as well as the matching conditions in phase space, are obtained from the electron trajectories. A comparison with the numerical solution is presented.

1226 **(UCRL—91938) Initial measurements of beam breakup instability in the advanced test accelerator.** Chong, Y.P.; Caporaso, G.J.; Struve, K.W. (Lawrence Livermore National Lab., CA (USA)). 13 May 1985. Contract W-7405-ENG-48. 14p. (CONF-850504—290). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001583.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

This paper reports the measurements of beam breakup (BBU) instability performed on the Advanced Test Accelerator (ATA) up to the end of February, 1984. The main objective was to produce a high current usable electron beam at the ATA output. A well-known instability is BBU which arises from the accelerator cavity modes interacting with the electron beam. The dominant mode is TM_{130} at a frequency of approximately 785 MHz. It couples most strongly to the beam motion and has been observed to grow in the Experimental Test Accelerator (ETA) which has only eight accelerator cavities. ATA has one hundred and seventy cavities and, therefore, the growth of BBU is expected to be more severe. In this paper, BBU measurements are reported for ATA with beam currents of 4 to 7 kA. Analysis showed that the growth of the instability with propagation distance was as expected for the lower currents. However, the high-current data showed an apparent higher growth rate than expected. An explanation for this anomaly is given in terms of a "corkscrew" excitation. The injector BBU noise level for a field emission brush cathode was found to be

an order of magnitude lower than for a cold plasma discharge cathode. These injector rf amplitudes agree very well with values obtained using the method of differenced B sub solar loops.

1227 **(UCRL—91940) Recent progress of the advanced test accelerator.** Prono, D.S. (Lawrence Livermore National Lab., CA (USA)). 13 May 1985. Contract W-7405-ENG-48. 21p. (CONF-850504—288). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001578.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Attempts to further improve the beam brightness from field emission cathodes are currently centered on the issue of how beam optics and phase mixing within the injector transport tend to "average down" the beam brightness. Particle simulation work indicates that beam brightness can be significantly improved by simply reducing the injector transport magnetic field and losing peak transport current, i.e., only transporting that high brightness portion of the total current. The simulation results shown in Figure 8 suggest that beam brightness can be increased perhaps a factor of 5 or more simply by "tuning for brightness" rather than tuning for peak transported current. If this can indeed be experimentally realized and the resulting beam matched onto accelerator transport (magnetic and/or laser guided) without emittance degradation then simple field emission cathodes would, at least in the immediately near term, saisfy the needs for 10 micron FEL experiments. 8 refs., 8 figs.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 1263, 1632

1228 **(DOE/ER/02504—437) High energy accelerator and colliding beam user group. Progress report .** (Maryland Univ., College Park (USA)). Oct 1985. Contract AC05-76ER02504. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001896.

The OPAL project at LEP has begun to dominate the research activites at Maryland. A very large new laboratory has been commissioned in the Physics Building. In this laboratory wire chambers and pads are being assembled and tested before shipment to CERN for insertion in the iron magnet calorimeter. Detailed design of most of the calorimeter has been completed, along with a plan for assembly and testing of the barrel calorimeter at CERN. A chamber production facility is being set up at Maryland to supplement the facility at Frascati that has been the source of all the chambers to date. The Frascati operation is carried out by our Bologna collaborators with some Maryland help. Production of part of the forward electromagnetic calorimeter has also begun in collaboration with University College, London. Excellent progress has been made on the problem of simulating the hadron calorimeter's response to multi GeV hadrons. Detailed Monte Carlos using a new OPAL program GEANT3/GHEISHA have been able to fit the Maryland caloimeter prototype test data taken at BNL.

1229 **(DOE/ER/10742—4) Development of an x-ray beam line at the NSLS for studies in materials science using x-ray absorption spectroscopy. Progress report.** Sayers, D.E. (North Carolina State Univ., Raleigh (USA). Dept. of Physics). 1 Oct 1985. Contract AS05-80ER10742. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001954.

This has been an exciting year for our PRT, highlighted by the running of the NSLS x-ray ring in an operational mode beginning in May of this year. Our line X-11A was the first to obtain an experimental spectrum and the first to publish a paper with results from the x-ray ring. These early successes have allowed us to run in an operational mode during the entire time that the x-raying ring itself has been operational. In addition to a number of exciting initial scientific results described, the initial results, particularly in the four crystal mode, have verified our original optical design and demonstrated an improved resolution using the four crystals. This will have a significant impact on near edge (XANES) studies.

1230 **(FNAL-TM—1351) Thermal shield bowing in long superconducting magnets.** Nicol, T.H.; Roman, M.; Fulton, S. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1985. 9p. (CONF-850814—14). NTIS, PC A02/MF A01. File Number DE86000643.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

One of the interesting problems associated with building long magnets for the SSC (Superconducting Super Collider) is predicting and controlling the dynamic response of the cryostat tubes during cooldown. Thermal bowing occurs in any of these tubes that are asymmetric in shape or which are not cooled uniformly. Understanding the bowing behavior is important for two reasons. First, one needs to know the magnitude of the induced displacements so that potential interferences in the entire magnet assembly can be located. Second, the bowing phenomenon introduces structural loads on the supports which need to be folded into the design of those supports. It is desirable, due to cost and time constraints, to develop an analytical model which accurately predicts loads and displacements rather than relying on a physical model of each candidate cryostat tube design. This report describes a procedure and an analytical model to predict this dynamic behavior on the thermal radiation shield for Fermilab's proposed SSC magnet design. The results are compared with test data obtained on a physical model fabricated and tested in an effort to verify the analytical approach.

1231 **(GEPP-OP—896) Applications of nuclear reaction analysis to metal hydride film characterization at the GEND 200 KeV accelerator facility.** Malbrough, D.J.; Becker, R.H. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 1985. Contract AC04-76DP00656. 28p. (CONF-8504183—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001663.

From 7. General Electric (GE) company-wide materials characterization symposium; Schenectady, NY, USA (22 Apr 1985).

Nuclear reaction analysis (NRA) is a quantitative analytical technique that usually involves the use of MeV ion beams and resonant nuclear reactions to non-destructively probe materials for elemental content and depth profiles. Low energy, non-resonant nuclear reactions can also be exploited for NRA and procedures have been developed for using the GEND 200-KeV accelerator to characterize neutron generator components by that technique. The procedures involve the detection and analysis of fusion reaction products generated by the interactions of deuteron beams with light elements in metal hydride films. A description of the accelerator system is presented along with some of the unique NRA procedures that have recently been developed for its use. The system is used to measure neutron output efficiencies of metal deuterides and tritides by the associated particle technique (APT) and accurate neutron yield measurements have been made for a number of materials for which data was formerly not available.

1232 **(GSI—85-14) Self-consistent and non-self-consistent phase space distributions of intense ion beams.** Struckmeier, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Fachbereich Physik). May 1985. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752696.

The present thesis is arranged in the following five main parts: In section 2 the foundations are briefly summarized, i.e. the Vlasov equation, the rms KV differential equation and from this the KV equations following for the special case of the KV distribution are derived. By the examples of solution functions of the KV equations shown in section 3 the term of a 'fitted' and 'misfitted' beam are explained. The perturbation theory of the KV equations presented in the following yields an example for the occurrence of structural resonances. To the effects by nonstationary initial distributions in simulation calculations is submitted in section 4. The study of the distribution dependence of structural-resonance effects is performed throughout by simulation calculations. It is shown that both effects can be discriminated without difficulties. The construction of stationary distributions in constant focusing forces is performed in section 5 for two analytically resolvable cases (KV and water-bag distribution). By a canonical transformation which fits

the distributions stationary in the constantly focusing system to a periodically focusing system it is shown that the transformed distributions are even in the periodical case stationary solution of the Vlasov equation. The final topic forms in section 6 the discussion of the earlier treated beam effects with regard to the GSI beam transport experiments.

1233 (INIS-mf—9910-Vol.1, pp 1-19) **ZEBRA, the first stage of an accelerator breeder program.** Schriber, S.O. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1983. NTIS (US Sales Only), PC A21/MF A01. File Number DE86780088. (CONF-830660—Vol.1).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

It may be essential to have an option in the future that could supply some of the fissile fuel requirements for nuclear power stations operating on advanced fuel cycles. An option that looks attractive technologically is the accelerator breeder. Research and development work associated with an accelerator breeder program has been underway at Chalk River Nuclear Laboratories for a number of years. Most of the activities have been directed towards the development of the technology required for suitable high-current, high-energy linear accelerators. The rationale for an accelerator breeder development program involving four stages is described along with associated economics and design optimization. A staged development program permits periodic reviews in the light of technological developments and future considerations, including social, political and economic factors. A description of each stage and the opportunities available for research and development are given. The first stage, a 300 mA - 10 MeV proton linac, ZEBRA (Zero Energy Breeder Accelerator), is described in more detail including the status of siting the ZEBRA project at a new laboratory in Quebec. Prior to construction of ZEBRA, a number of pre-ZEBRA activities are underway in the accelerator and the target/blanket areas. These activities are described in relation to the overall program goals.

1234 (INIS-SU—302, pp 44-46) **New positron source for the Kharkov electron linac.** Artemov, V.I.; Vishnyakov, V.A.; Dem'yanenko, G.K.; Dobromirov, S.A.; Kobezskij, V.M.; Peev, F.A.; Fisun, A.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE85781610. (CONF-8210133—Vol.2).

From 8. All-Union conference on the charged particle accelerators; Protvino, USSR (19 Oct 1982).

Results of investigation and operation of the Kharkov linac positron source (PS) are presented. 150 MeV initial electron beam is focused by means of a qudrupole triplet on tungsten converter with 1.66 thick of radiation length (5.5 mm). Using a short selenoid the positron beam emittance is matched with the acceptance of sequential part of PS. Results of simulation of positron dynamics in accelerating focusing channel of PS are given. Positron beam is transported from PS to the accelerator outlet, where its parameters proved to be as follows: energy - 1200 MeV, current-10 nA, emittance-1.2 mmxmrad. Losses in the main part of the accelerator are due to low acceptance of the channel, which is designed for electron beam transport and constitutes the value of about 4 mmxmrad. In this case, efficient factor of conversion equals 2×10^{-4}.

1235 (INIS-SU—302, pp 143-146) **Formation of the Erevan synchrotron magnetic cycle in the mode of heavy ion acceleration.** Goncharenko, V.P.; Gusev, O.A.; Lebedev, A.P.; Rezchikova, N.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)); Laziev, Eh.M.; Martirosyan, G.A.; Sadoyan, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1983. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE85781610. (CONF-8210133—Vol.2).

From 8. All-Union conference on the charged particle accelerators; Protvino, USSR (19 Oct 1982).

Investigations on reconstruction of power supply system of EHKU-6 electron synchrotron are carried out to ensure acceleration regimes for both electrons with the maximum energy 4.5 gev and heavy ions with the energy up to 500 mev/nucleon and acceleration repetition rate 50 hz. An isochronous cyclotron of the u-200 type is intended to be used as a heavy ion injector. For the power supply system EHKU-6 a circuit developed and manufactured for the regime of flat top formation for slow extraction of electrons is taken as a basis. It differs from the existing one in the introduction into circuit on initial winding of matching reactors, two thyristor keys, commutating capacitor and in electromagnet circuit in the presence of additional electric coil and keys. Parameters of EHKU-6 power supply system in the regime of flat-top formation for the beam slow extraction are presented.

1236 **(IPNO-DRE—83-33) Detection of low energy electrons at ISOCELE. Application to the study of ^{185}Hg and ^{187}Hg.** Bourgeois, C.; Kilcher, P.; Wojtasiewicz, A. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 18p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752926.

The measurement of the low-energy electrons ($1 <= Esub(e) <= 500KeV$) emitted from short-lived nuclei has been developed by using a semi-circular spectrograph working on-line to the ISOCELE mass separator. Results concerning the decays of ^{185}Hg and ^{187}Hg are presented as examples.

1237 **(IPNO-GTA—84-14) Study of a double buncher for the axial injection in a cyclotron.** Hennino, T. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 19p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752934.

Some aspects of a double buncher designed to turn a continuous beam into bunches of minimum duration with maximum efficiency are studied. The sinusoidal voltages, with frequency f and 2f, applied to the two elements of the buncher are calculated for different geometrical configurations. Phase dispersion values as low as 1° are obtained with relatively low voltages. The bunching deterioration due to source noise, voltage instabilities or phase misalignment is outlined.

1238 **(LA-UR—85-3176) New high-brightness electron injector for free-electron lasers driven by rf linacs.** Fraser, J.S.; Sheffield, R.L.; Gray, E.R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 22p. (CONF-850956—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000781.

From 6. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

A free-electron laser oscillator, driven by an rf linac, requires a train of electron bunches delivered to an undulator. The brightness requirement exceeds that available from a conventional linac with rf bunchers. The demonstrated high brightness of laser-illuminated photoemitters indicates that the conventional buncher system might be eliminated entirely, thereby avoiding the usual loarge loss in brightness that occurs in bunchers. A photoemitter with a current density of about 200 A/cm^2 is placed on an end wall of an rf cavity to accelerate a 60-ps bunch of electrons to 1 MeV as rapidly as possible. Preliminary experimental work, simulation calculations, and discussions on emittance measurement techniques and positive ion motion in the rf gun are presented.

1239 **(LBL—19171) High energy heavy ions: techniques and applications.** Alonso, J.R. (Lawrence Berkeley Lab., CA (USA)). Apr 1985. Contract AC03-76SF00098. 30p. (CONF-850470—11). NTIS, PC A03/MF A01; GPO Dep. File Number DE86000602.

From 4. international conference on electrostatic accelerator technology and associated boosters; Buenos Aires, Argentina (15 Apr 1985).

Pioneering work at the Bevalac has given significant insight into the field of relativistic heavy ions, both in the development of techniques for acceleration and delivery of these beams as well as in many novel areas of applications. This paper will outline our experiences at the Bevalac; ion sources, low velocity acceleration, matching to the synchrotron booster, and beam delivery. Applications discussed will include the observation of new effects in central nuclear collisions, production of beams of exotic short-lived (down to 1 μsec) isotopes through peripheral nuclear collisions, atomic

physics with hydrogen-like uranium ions, effects of heavy "cosmic rays" on satellite equipment, and an ongoing cancer radiotherapy program with heavy ions. 39 refs., 6 figs., 1 tab.

1240 **(UCRL—91878) Numerical simulation of an accelerator injector.** Boyd, J.K.; Caporaso, G.J.; Cole, A.G. (Lawrence Livermore National Lab., CA (USA)). 9 May 1985. Contract W-7405-ENG-48. 13p. (CONF-850504—291). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001572.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Accelerator injector designs have been evaluated using two computer codes. The first code self consistently follows relativistic particles in two dimensions. Fields are obtained in the Darwin model which includes inductive effects. This code is used to study cathode emission and acceleration to full injector voltage. The second code transports a fixed segment of a beam along the remainder of the beam line. Using these two codes the effects of electrode configuration on emittance, beam quality and beam transport have been studied.

1241 **(UCRL—91912) Analytical methods of electrode design for a relativistic electron gun.** Caporaso, G.J.; Cole, A.G.; Boyd, J.K. (Lawrence Livermore National Lab., CA (USA)). 9 May 1985. Contract W-7405-ENG-48. 9p. (CONF-850504—292). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001584.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The standard paraxial ray equation method for the design of electrodes for an electrostatically focused gun is extended to include relativistic effects and the effects of the beam's azimuthal magnetic field. Solutions for parallel and converging beams are obtained and the predicted currents are compared against those measured on the High Brightness Test Stand. 4 refs., 2 figs.

4304 Storage Rings

1242 **(BNL—37082) Tuning the rf cavity by using a detuning loop.** Wang, Y.M.; Keane, J.; Batchelor, K. (Brookhaven National Lab., Upton, NY (USA)). Sep 1985. Contract AC02-76CH00016. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001179.

The tuning of the rf cavity with a coupling loop connected to a variable capacitor or an open or shorted coaxial line is described. Two kinds of equivalent circuits are described and some of the calculations of Δf and Q vs capacitance curves are given. At 52 MHz the maximum practical tuning range is about 100 KHz, if the parameters of tuning circuit are chosen properly so that the Q of the accelerating cavity does not decrease too much.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 603, 690, 1087, 1199, 1228, 1371, 1574, 1813

1243 **(AD-A—155842/8/XAB) Wholebody radiation counting system. Final report.** Fechter, G.M. (Army Military Personnel Center, Alexandria, VA (USA)). 1 May 1985. 133p. NTIS, PC A07/MF A01.

The purpose of this research was to develop a system that would allow the Health Physics staff of the Nuclear Engineering Department of Rensselaer Polytechnic Institute to conduct wholebody radiation counting of all assigned personnel and to determine if a multiple-crystal arrangement had any benefits over the single-crystal system. The research had three main objectives: to design and construct the electronic hardware necessary to collect data from a series of three NaI(Tl) scintilation crystals; to develop the computer software necessary to interpret this data and calculate concentrations present within those individuals tested; and to interface the Helgeson Wholebody Counter with the Vax 11/750 Computer System. This system includes a Texas Instruments TM990-101M Microcomputer which acts as the main control unit for the operator and as the interface with the Vax computer. Additionally, the final system included a computer interface and data acquisition module and it uses a Digital Equipment Corporation VAX 11/750 Computer System for a majority of the data manipulation. This system, as all wholebody counting systems, is characterized by its ability to detect low levels of radionuclide concentration while maintaining adequate resolution to identify the exact isotopes present within the person being counted.

1244 (BNL—51847, pp 11-20) **Small-angle x-ray scattering instrumentation for structural biology at the National Synchrotron Light Source.** Wise, D.S.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The criteria and constraints that were used as a basis for the design of the biology small-angle scattering (SAXS) beam line are outlined. The optics, spectrometer, detectors, and data acquisition system are described in detail.

1245 (BNL—51847, pp 73-84) **Investigations of time resolved x-ray wide-angle scattering and x-ray small-angle scattering at DESY.** Zachmann, H.G.; Gehrke, R.; Prieske, W.; Riekel, C. (Univ. Hamburg, West Germany). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Instrumentation is described for the simultaneous wide-angle and small-angle x-ray scattering. The method was applied to the study of the isothermal crystallization of polyethylene terephthalates. In agreement with the classical theories of crystallization, the data showed that the density difference between the crystals and the non-crystalline regions does not change with time. The mechanisms of melting, recrystallization, and crystal thickening were investigated by small-angle x-ray scattering with stepwise changes and continuous changes of temperature using polyethylene terephthalate.

1246 **(CEA-CONF—7773) Individual dosimeters for uranium mines.** Chapuis. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1983. 5p. (In French). (CONF-8212104—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752814.

From Mesucora congress; Paris, France (8 Dec 1982).

The dosimeter is designed for the continuous measurement of the concentration of α-emitters from the uranium 238 and thorium 232 series in suspension in air. It enables the measurement of firstly the aerosol concentration of polonium 218, 214 and 212 and of bismuth 212 and hence the α potential energy per unit volume and secondly the activity per unit volume of the long-lived α emitters in suspended ore dust. The bearing of the dosimeter by 160 miners during several months proved the technological validity of the devices and the accuracy of this dosimetry.

1247 **(CEA-CONF—7774) Individual dosemeter with ionization chamber for intervention.** Prigent, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1982. 7p. (In French). (CONF-8212104—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752816.

From Mesucora congress; Paris, France (8 Dec 1982).

The altogether intervention ratemeter-dosemeter is a device for work condition control and for dosimetry of intervention gang in hostile medium. A portable irradiation marker with ionization chamber either carried by staff, or put at the work post, delivers an information function of the surrounding irradiation field in which moves the intervention staff. The information is processed so as the absorbed dose rate and the absorbed dose are given simultaneously. The connection between the marker and the process device is made by a cable (up to 100m) or by radio link.

1248 **(CEA-R—5290) Analysis software for gamma spectrometry developed on an IN96 inter-technique multichannel analyser.** De Bruyne, T.; Silly, M.; Adam, A.; Laurec, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jan 1985. 110p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752846.

An analysis software for gamma spectrometry has been developed and implemented on an INTERTECHNIQUE multichannel analyser (IN96). This software makes the analyser standard programs easier to use and gives solutions to several other analysis problems. Special attention has been paid to multiplets analysis and to an automatical fitting detectors efficiency curve. Spectrum and other data manipulations have been made easy by the use of specific programs.

1249 **(DOE/ER/40033—90) Small angle silicon detector system of CDF.** Bertolucci, S.; Cordelli, M.; Curatolo, M.; Dulach, B.; Esposito, B.; Giromini, P.; Miozzo, S.; Sansoni, A.; Bedeschi, F.; Bellettini, G. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati; Pisa Univ. (Italy); Rockefeller Univ., New York (USA)). Mar 1985. Contract AC02-81ER40033. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001629.

The physics goals that can be pursued using silicon detectors at very small angles inside the Tevatron beam pipe are discussed. These goals span a wide field, covering measurements of luminosity, elastic scattering, diffraction dissociation, determination of the total cross section and search for new phenomena in large mass diffraction dissociation. 8 figs., 5 tabs.

1250 **(DOE/EV/01105—316) Response of a γ-ray "telescope" dosimeter to the (n + γ) radiation from a ^{239}Pu-Be source.** Attix, F.H.; Pearson, D.W.; DeLuca, P.M. Jr. (Wisconsin Univ., Madison (USA). Dept. of Medical Physics). 1985. Contract AC02-76EV01105. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000850.

The design, construction, and investigation of a gamma-ray telescope that can tell the direction of incident photons is reported. The dosimeter is based on LiF thermoluminescence. The gamma-ray telescope dosimeter was tested with a ^{239}Pu-Be source and found to perform satisfactorily. For a high-energy neutron field the gamma-ray telescope dosimeter contributes very little to the total dose equivalent. (LEW)

1251 **(EGG—10282-2068) Mercuric iodide x-ray camera.** Patt, B.E.; Del Duca, A.; Dolin, R.; Ortale, C. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). 1985. Contract AC08-83NV10282. 4p. (CONF-851097—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001103.

From IEEE symposium; San Francisco, CA, USA (23 Oct 1985).

A prototype x-ray camera utilizing a 1.5- by 1.5-in., 1024-element, thin mercuric iodide detector array has been tested and evaluated. The microprocessor-based camera is portable and operates at room temperature. Events can be localized within 1 to 2 mm at energies below 60 keV and within 5 to 6 mm at energies on the order of 600 keV. 5 refs., 7 figs.

1252 (INIS-mf—9910-Vol.2, pp 73-85) **Benefit of gamma scanning to the chemical process industry.** Minns, D.E. (Atomic Energy of Canada Ltd., Ottawa, Ontario (Canada). Chemical Company); Niemi, A.D. (Atomic Energy of Canada Ltd., Glace Bay, Nova Scotia (Canada). Glace Bay Heavy Water Plant). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

Gamma scanning as an on-line, non-intrusive, diagnostic tool for the chemical process industry was pioneered more than 20 years ago by Dupont. In the early 1970's, the technique was considerably advanced by AECL at CRNL for use in the Canadian heavy water industry. Gamma scanning gives unique hydraulic performance data on operating towers and has been used very extensively by Ontario Hydro at Bruce Heavy Water Plant and by AECL, with the Nova Scotia Research Foundation, at Bruce Heavy Water Plant and Port Hawkesbury Heavy Water Plant. Specifically, it has been used to diagnose the cause of unstable operation, refine the use of antifoams and to give essential tray performance data. This latter has allowed AECL at CRNL to develop the most sophisticated tray design capability available for GS heavy water plant operation. This paper details the gamma scanning technique, indicating its range of application and describing case histories of its spin-off application to the chemical processing industry.

1253 (INIS-mf—9910-Vol.2, pp 25-49) **Future of high technology nuclear instrumentation in non-nuclear fields. The neutron perspective.** Bot, D.L. (Bot Engineering Ltd., Milton, Ontario (Canada)). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

We have concentrated our efforts on designing and building a device that can measure neutron energy spectra on a realtime basis. With the capability of making simple neutron energy measurement we feel quite confident that the physics that govern the neutrons behaviour as encountered in a measurement environment can be better utilized than it has to date. This paper discusses the simple physics that govern the operation of some of today's neutron-based devices and discusses how tomorrow's instruments will improve performance by making the energy dimension a measureable quantity. The paper also discusses the ingredients of our spectrometer that make it quite different from any neutron measurement system now in existance and reviews our end goal of providing a neutron 'development system' that will use both our spectrometer and computer simulations as means of devising and optimizing new neutron measurement techniques.

1254 **(IPNO-DRE—84-16) ^{252}Cf time of flight mass spectrometer with improved mass resolution.** Della Negra, S.; Le Beyec, Y. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752937.

An electrostatic mirror has been built to achieve time focusing and high mass resolution with a new ^{252}Cf time of flight mass spectrometer. The first results show that M/AM(50%) values are around 2500 for organic molecules. The apparatus is described and results are presented. Future applications for metastable ion studies are briefly discussed.

1255 **(LA-UR—85-3455) Radiation dosimetry through spectral definition.** Dowdy, E.J.; Moss, C.E.; Robba, A.A.; Evans, A.E.; Lucas, M.C.; Shunk, E.R.; Goulding, C.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 25p. (CONF-850925—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000797.

From 3. international symposium on radiation physics; Ferrara, Italy (30 Sep 1985).

We have developed a fieldable instrumentation system for determining from measured flux spectra, both the neutron and gamma ray dose rate distributions associated with radioactive sources. This system includes the sensors, the computer-based data acquisition and analysis hardware, and the requisite software for unfolding the sensor response functions to obtain the flux spectra, and for folding the resultant flux spectra with appropriate flux spectrum-to-dose conversion factors. We use bismuth germanate scintillators that have experimentally measured and analytically interpolated response functions to determine the gamma ray flux spectra, and a suite of neutron sensors, based on proton recoil and ^{3}He capture, to determine the neutron flux spectra. In addition, gamma ray peak identification is done using HPGe sensors. We describe the equipment and procedures and present some recent results. 10 refs., 15 figs.

1256 **(LPC—84-21) Fast algorithm of track reconstruction for the Delphy TPC.** Maillard, J. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). 1984. 44p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752074.

We describe a simple geometrical method (polar inversion) to reconstruct tracks. When the magnetic field is constant in magnitude and direction. This method uses geometrical properties of the trajectories. In the case of the DELPHI apparatus, the track reconstruction is done using TPC informations. After explaining the algorithm, we give results on "GEANT" simulated events using the "Lund" generator. Today we get a computer time of the order of 1.2 milliseconds on a CDC 7600 and an efficiency of 98%.

1257 **(LYCEN—8344) Performances of an electromagnetic calorimeter to study the charmonium states produced in anti pp annihilation at CERN ISR.** Tij, M. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 101p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752924.

We expose the description and performances of an electromagnetic calorimeter, the aim of which is to detect photons and electrons in the energy range 1 to 5 GeV, issued from antipp annihilation near the phi state (charmonium spectroscopy in the CERN ISR). This calorimeter is composed of 4.7 X_0 lead-NE110 scintillator sandwiches, 1 X_0 of analogic gas chambers and 10X_0 of lead-glass. The energy resolution is 29 to 30% / $\sqrt{E}$ (FWHM) for 1 to 5 GeV electromagnetic showers. The gain monitoring system comprises light emitting diodes generators which are coupled to optical fibers. These light generators are controlled by means of silicon photodiodes.

1258 **(PNL-SA—13225) Portable instruments for emergency response.** Swinth, K.L. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 16p. (CONF-8506136—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85017928.

From Health physics summer school conference; Evanston, IL, USA (3 Jun 1985).

The selection and use of instruments for emergency response is complicated by lack of specific guidance, the diversity of potential conditions, and the variable performance of available instruments. The user must examine the projected radiological conditions during an accident and the environmental extremes that could exist. This should assist in determining requirements that the instruments must meet during an emergency. Due to the variable performance of available instrumentation, critical parameters (temperature dependence) should be tested prior to use to assure adequate measurements. Although it is tempting to stock emergency kits with inexpensive monitoring equipment, one should carefully consider the possible conditions (environmental, radiological) and equipment performance since inaccurate measurements could be very costly in terms of decisions regarding lifesaving and evacuation during an emergency. 15 refs., 1 fig., 3 tabs.

1259 **(SAND—85-1936C) MOS-transistor radiation detectors and x-ray dose-enhancement effects.** Posey, L.D.; Wrobel, T.F.; Evans, D.C.; Beezhold, W.; Kelly, J.G.; MacCallum, C.J.; Coppage, F.N.; Luera, T.F.; Smith, A.J. (Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 7p. (CONF-8510165—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001320.

From 6. JOWOG meeting; Aldermaston, England (7 Oct 1985).

Sandia National Laboratory (SNL) CMOS IC dose detectors and 3N161 MOS Transistors were evaluated as pulsed x-radiation dosimeters and used as monitors to measure dose-enhancement effects. Measurements were made in the photon environments from the HydraMITE II, SPR III, MBS and PITHON radiation sources. The dosimetric evaluation data suggest that the 3N161 MOS transistors are useful dosimeters for measuring flash x-ray-induced doses in the oxide layers of modern metal-oxide-semiconductor (MOS) integrated circuits. However, dose-enhancement calculations indicate that Monte Carlo codes, using 1-D geometries and calculated source spectra, consistently overpredict measured dose-enhancement ratios by factors as large as two. 12 refs., 8 figs., 2 tabs.

1260 **First use of a mercuric iodide (HgI_2) energy dispersive x-ray detector in a scanning electron microscope.** Iwanczyk, J.S.; Dabrowski, A.J.; Huth, G.C.; Bradley, J.G.; Conley, J.M.; Albee, A.L. (Univ. of Southern California, Marina del Rey). *Scanning Electron Microscopy;* 9-14(1984). Contract AM03-76SF00113.

A room temperature mercuric iodide x-ray detector system with a Peltier cooled field effect transistor and pulsed optical feedback preamplifier has been constructed and tested in a scanning electron microscope. The initial system achieved an energy resolution of 220 eV (FWHM) for Mg-K line at 1.25 keV and 360 eV for Mn-Kα at 5.9 keV. This resolution is adequate for many applications. Improved energy resolution and low energy sensitivity should be readily achievable through simple changes to the not-optimized system tested.

1261 **(DOUNREAY-TRANS—894) New type of measuring device for monitoring conventional waste for the inadvertent inclusion of radioactive materials.** Rodenbaeck, B. (UKAEA Dounreay Nuclear Power Development Establishment; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Mar 1982. Translation source information not available . 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86900159.

For many years the conventional wastes of the Juelich Nuclear Research Centre have been monitored for the inadvertant inclusion of radioactive material before being transferred to a public refuse pit. This work was carried out by a health physics monitor. An automatic monitoring device has recently been installed. The main item of this testing device is a scintillator probe. The sensitivity and directional independence of the probe for various nuclides showed its suitability for monitoring wastes in steel containers. A suitable mechanism was designed for this purpose. The container provided for the transport of waste stands in a container pit over which a trolley on rails can pass. Two gamma probes are mounted on the front part of this trolley. If no activity is detected the device ejects a test certificate in the form of a card, similar to a car park ticket. During the whole of the measuring procedure a barrier prevents the container leaving. If radioactive constituents are present the barrier continues to prevent the container leaving. Simultaneously a signal is generated which leads to an inspection of the rejected container. 1 ref., 6 figs.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 72, 195, 1199, 1229

1262 **(ANL—85-61) Experimental operation of a sodium heat pipe.** Holtz, R.E.; McLennan, G.A.; Koehl, E.R. (Argonne National Lab., IL (USA)). May 1985. Contract W-31-109-ENG-38. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86002550.

This report documents the operation of a 28 in. long sodium heat pipe in the Heat Pipe Test Facility (HPTF) installed at Argonne National Laboratory. Experimental data were collected to simulate conditions prototypic of both a fluidized bed coal combustor application and a space environment application. Both sets of experiment data show good agreement with the heat pipe analytical model. The heat transfer performance of the heat pipe proved reliable over a substantial period of operation and over much thermal cycling. Additional testing of longer heat pipes under controlled laboratory conditions will be necessary to determine performance limitations and to complete the design code validation. 2 refs., 23 figs., 2 tabs.

1263 **(BNL—37050) Metrology of reflection optics for synchrotron radiation.** Takacs, P.Z. (Brookhaven National Lab., Upton, NY (USA)). Sep 1985. Contract AC02-76CH00016. 51p. (CONF-850734—12). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001205.

From 2. international synchrotron radiation instrumentation conference; Stanford, CA, USA (29 Jul 1985).

Recent years have seen an almost explosive growth in the number of beam lines on new and existing synchrotron radiation facilities throughout the world. The need for optical components to utilize the unique characteristics of synchrotron radiation has increased accordingly. Unfortunately, the technology to manufacture and measure the large, smooth, exotic optical surfaces required to focus and steer the synchrotron radiation beam has not progressed as rapidly as the operational demands on these components. Most companies do not wish to become involved with a project that requires producing a single, very expensive, aspheric optic with surface roughness and figure tolerances that are beyond their capabilities to measure. This paper will review some of the experiences of the National Synchrotron Light Source in procuring grazing incidence optical components over the past several years. We will review the specification process - how it is related to the function of the optic, and how it relates to the metrology available during the manufacturing process and after delivery to the user's laboratory. We will also discuss practical aspects of our experience with new technologies, such as single point diamond turning of metal mirrors and the use of SiC as a mirror material. Recent advances in metrology instrumentation have the potential to move the measurement of surface figure and finish from the research laboratory into the optical shop, which should stimulate growth and interest in the manufacturing of optics to meet the needs of the synchrotron radiation user community.

1264 (BNL—51847, pp 105-122) **Lithography requirements in complex VLSI device fabrication.** Wilson, A.D. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Fabrication of complex very large scale integration (VLSI) circuits requires continual advances in lithography to satisfy: decreasing minimum linewidths, larger chip sizes, tighter linewidth and overlay control, increasing topography to linewidth ratios, higher yield demands, increased throughput, harsher device processing, lower lithography cost, and a larger part number set with quick turn-around time. Where optical, electron beam, x-ray, and ion beam lithography can be applied to judiciously satisfy the complex VLSI circuit fabrication requirements is discussed and those areas that are in need of major further advances are addressed. Emphasis will be placed on advanced electron beam and storage ring x-ray lithography.

1265 (CEA-NT—59) **Experimental device for the measurement of Curie point.** Sapin, M.; Peix, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1985. 15p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752847.

The different steps for the design and fabrication of a "Curie point" detector are described, from the magnetic circuit up to the data output.

1266 (CONF-851238—2) **Diagnostic applications of millimeter waves in coal conversion systems.** Gopalsami, N.; Raptis, A.C. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001790.

From International conference on infrared and millimeter waves; Lake Buena Vista, FL, USA (8 Dec 1985).

The feasibility of millimeter-wave (MMW) techniques is discussed for in-situ diagnostics of particulate-laden multiphase streams in coal conversion and combustion systems. The techniques investigated include MMW spectroscopy for determination of molecular species and gas-phase temperature, MMW radiometry for particle temperature measurement, and MMW scattering for particle characterization. The theoretical feasibility of each technique is presented together with the applicable range of measurement/system parameters. 3 refs.

1267 (IS-T—1189) **Analytical applications of ultrasensitive polarization measurements.** Bobbitt, D.R. (Ames Lab., IA (USA)). Oct 1985. Contract W-7405-ENG-82. 205p. NTIS, PC A10/MF A01; GPO Dep. File Number DE86002116.

Thesis.

For analytical applications, an often overlooked property of light is its plane of polarization. However, since life processes usually favor one enantiomeric isomer, polarization sensitive techniques are necessary to answer a variety of chemical questions. The crux of this thesis, therefore, will be to present recent advances in the measurement and utilization of the polarization properties of light. Since optical activity is usually an indication of biological activity, past or present, optical rotation detection (ORD) can impart a unique selectivity to the chromatographic analysis of complicated geochemical samples. The advantages of selective detection are demonstrated for several coal liquids, and LC-ORD is shown to be useful for the fingerprinting of coals as well as for following the degree of processing of a fossil fuel. A recent trend in liquid chromatography has been the development of microcolumn technology. Microcolumns can be operated at reduced cost, and frequently, with improved efficiency over conventional sized columns. Using selected Glan-Thompson polarizing prisms, a liquid based Faraday modulation cell and a laser source, a micropolarimeter has been constructed with a one microliter flow cell that is compatible with microcolumn chromatography. Finally, Raman spectra can be obtained by monitoring the polarization properties of a probe field while it interacts with a Raman shifted pump field. An analytical investigation of this technique, the Raman induced Kerr effect is presented, along with a unique optical null capable of suppressing spectral and nonresonant background interferences. 198 references.

1268 (UCRL—92214) **Performance characterization of an image converter based streak camera.** Lai, C.C.; Olk, L.B. (Lawrence Livermore National Lab., CA (USA)). 20 Aug 1985. Contract W-7405-ENG-48. 9p. (CONF-850887—39). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001567.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

The performance response of an electronic subnanosecond streak camera to a spatially distributed optical signal varies significantly with the image location on output screen. The variations are due mainly to the combined effects of (1) electron-optics aberrations, (2) camera sweep ramps and gating waveform imperfections, (3) photocathode and phosphor quantum efficiency nonuniformities, and (4) excessive incident intensity or power. Consequently, a dynamic full-scale characterization of the streak camera is necessary for achieving a better measurement accuracy, relative or absolute. To meet this need, we are developing a simple yet versatile technique for characterizing the large-format image-converter-tube based streak cameras that are routinely used as the prime diagnostic instruments at the nuclear test site in Nevada. A mode-locked pulsed dye laser routing through beam splitters and mirrors provides the repetitive light source of multiple pulses with known intensities and inter-pulse timing for illumination along the streak sweep axis. Meanwhile, a bar-chart test pattern at the input slit intercepting an expanded form of the light source, or a bundle of equal-length fibers fanning out into a linear line array replacing the slit, distributes the illumination along the axis perpendicular to the sweep. In one single shot, this technique enables an accurate and detailed mapping of the key performance parametes of a large-format streak camera. The obtainable parameters include quantitative temporal and spatial resolutions, descriptive dynamic range, two-dimensional sweep nonlinearity, and intensity or power dependent distortions. Experimental setup is described. Sample test data, digitization plots, and computer analysis results are presented.

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4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 1199

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 1274

1269 **(MLM—3296(OP)) Thermographic observation of hydrocarbon oxygen explosions.** Abney, L.D.; Kelly, M.D.; Mohler, J.H. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1985. Contract AC04-76DP00053. 4p. (CONF-8509181—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001757.

From 8. thermosense conference; Cambridge, MA, USA (16 Sep 1985).

Balloons containing methane-oxygen mixtures were detonated to simulate ordinance fireballs. To establish fireball characteristics, analyses were required of reacting temperatures, thermal profiles, and mixing patterns of the methane-oxygen products with the atmosphere. Infrared videothermography measured and recorded the detonation and gas cloud mixing. Image digitization and in-band energy calculations were done to compare reaction parameters for different balloon tests.

1270 **(SAND—85-1686) Application of hydrogen analysis to the compatibility testing and long-term aging of explosives.** Klassen, S.E.; Womelsduff, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001689.

The addition of a hydrogen transfer system (Carle Instruments) to a Hewlett-Packard 5880A gas chromatograph has enabled us to quantitate hydrogen in addition to other gases produced during compatibility testing of explosives. This report describes our particular modification and gives results which describe its capabilities. 9 refs., 4 figs., 3 tabs.

1271 **(SRD-R—262) Computational survey of the factors influencing the pressure fields produced by unconfined vapour cloud explosions.** MacKenzie, J. (UKAEA Safety and Reliability Directorate, Culcheth). Mar 1983. 32p. United Kingdom Atomic Energy Authority, Wigshaw Lane, Culcheth Warrington, England WA3-4N. File Number TI85901931.

The explosion modelling code GASEX1 has been used to investigate the effects of various parameters on the pressure fields produced by the combustion of flammable gas clouds. The parameters examined include fuel type, fuel concentration and burning velocity. Calculations with concentration gradients have also been carried out. 2 refs., 22 figs., 2 tabs.

1272 **(UCRL—92399) Finite deformations, Onsager irreversible thermodynamics, and stress analysis of shock waves.** Stout, R.B.; Larson, D.B. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 22p. (CONF-850953—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001579.

From 3. symposium on containment of underground nuclear explosions; Idaho Falls, ID, USA (10 Sep 1985).

Experimental results from a spherical source of chemical explosive in PMMA provided shock velocity, particle velocity, and stress measurements. The experimental results are used to evaluate Onsager relationships for dislocation dependent, nonequilibrium thermodynamic processes during shock wave propagation. Because shock energy is dissipated by the nonequilibrium processes, the shock wave approaches a steady wave far from the explosive source. The shapes of the measured steady wave profiles were approximately triangular for both the particle velocity and the stress histories immediately behind the shock front. Using this information, an approximate elastic analysis is performed for a triangular shock wave profile propagating from a point source. This analysis provided a model to discriminate between different diagonal components of the stress tensor that result from a spherically symmetrical shock wave. 16 refs., 4 figs.

1273 **(UCRL—93224) New approach for studying the expansion of detonation products.** Steinberg, D.; Chau, H. (Lawrence Livermore National Lab., CA (USA)). Aug 1985. Contract W-7405-ENG-48. 5p. (CONF-850706—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000746.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

Single crystal 100 LiF has well known mechanical and optical properties. Consequently, it has been used for many years as a window when studying inert materials via the velocimeter technique. Because of its close impendence match to detonating HE, we have used this technique to probe the expansion of detonation products. Our data on LX14 clearly show the Von Neumann spike as well as many other structures not yet identified. The best estimate for the CJ pressure is 35.3 GPa. 1 refs., 2 figs.

4502 Nuclear

1274 **(AD-A—156853/4/XAB) Study of the capabilities of six advanced soil models to predict responses to complex strain paths typical of explosively-induced ground motion. Technical report, 30 April-31 December 1982.** Read, H.E.; Ko, H.Y.; Baladi, G.Y.; Lade, P.V.; Prevost, J.H. (S-Cubed, San Diego, CA (USA)). 30 Apr 1983. 116p. (SSS-R—83-6081). NTIS, PC A06/MF A01.

The capabilities of six advanced soil models to predict the response of remolded Ralston Valley soil to complex strain paths were investigated in a joint, cooperative effort among several organizations. The complex strain paths were typical of those experienced by soil elements during nearby near-surface explosive ground motion events. The investigation involved both analysis and extensive laboratory testing. Standard laboratory tests were conducted to provide the usual type of data for fitting the models, while nonstandard laboratory tests were done to drive the soil around prescribed, fully three-dimensional complex strain paths and simultaneously measure the corresponding stress histories. To avoid possible unknown differences in testing equipment, all laboratory tests were done with a true triaxial device. The models were fit to the data from the standard laboratory tests, and then driven around the prescribed complex strain paths to predict the corresponding stress histories. Comparison between the predicted and measured stress histories formed the basis for evaluating the models. However, because of uncertainties that occurred in the data for the complex strain paths, a meaningful evaluation of the models could not be conducted. Recommendations are given for improving the testing procedures so that data of the required quality can be obtained in the future.

1275 **(ETCA—84-R-032) Neutronic spectral hardening of the Harmonie reactor: calculations and experiences.** Forest, I.; Dhermain, J.; Detroussel, P. (Etablissement Technique Central de l'Armement (ETCA), 94 - Arcueil (France)). Dec 1983. 45p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752845.

Spectral hardening, i.e. the increase of the spectrum average energy of neutrons produced by Cadarache CEA Harmonie reactor, has been calculated and experimentally tested by means of a polyethylene shell surrounding the core. Results show that a 8 cm polyethylene layer is enough to produce a spectrum with a hardness similar to that of a fission nuclear weapon. In these conditions, the reactor may be considered as a good simulator of the neutronic spectrum of the weapon.

1276 **(ORNL/Sub—83-43374/1/Vol.1) Study to assess the effects of electromagnetic pulse on electric power systems. Phase I. Executive summary.** Legro, J.R.; Abi-Samra, N.C.; Crouse, J.C.; Hileman, A.R.; Kruse, V.J.; Taylor, E.R. Jr.; Tesche, F.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Sep 1985. Contract AC05-84OR21400. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001430.

The high-altitude detonation of a nuclear device over the continental United States can expose electric utility power systems to intense, transient electromagnetic pulses (EMP). In addition to the initial transient fields designated as early-time, high-altitude EMP and intermediate-time, high-altitude EMP, electromagnetic signals are also produced at times from seconds to hundreds of seconds after the burst. Nuclear detonations at or near the earth's surface can also produce transient EMP. This volume presents an executive summary of the preliminary research effort to investigate the nature and coupling of EMP environments to electric power systems, define the construction of approximate system response models, and document the development of a methodology to assess equipment and system vulnerability. The research to date does not include an attempt to quantify power system performance in EMP environments. This effort has been to define the analytical methods and techniques necessary to conduct such assessments at a later time.

1277 **(ORNL/Sub—83-43374/1/Vol.4) Study to assess the effects of nuclear surface burst electromagnetic pulse on electric power systems. Phase I, final report.** Legro, J.R.; Abi-Samra, N.C.; Hileman, A.R.; Tesche, F.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Sep 1985. Contract AC05-84OR21400. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86001431.

The surface burst of a nuclear device, within the continental United States, can expose nearby portions of the civilian electric utility system to transient, source region electromagnetic pulse (SREMP). This threat is in addition to any coincident, non-SREMP damage to the system due to craterization, fireball, blast wave and radiation. The unique properties of the civilian electric power system, such as its complex electrical interconnection over a vast geographic area, strongly suggests that a separate SREMP assessment methodology should be prepared with specific focus on the power system. This volume documents a preliminary research effort to investigate the nature and coupling of the SREMP environment to electric power systems, define the attributes of system response, and document the development of a unified methodology to assess equipment and systematic vulnerability.

1278 **(ORNL/Sub—84/73986/1) HEMP-induced transients in transmission and distribution (T and D) lines.** Engheta, N.; Lee, K.S.H.; Yang, F.C.; Aguero, R. (Dikewood, Santa Monica, CA (USA)). Sep 1985. Contract AC05-84OR21400. 120p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86001443.

The corona effects on the early-time induced transients on the transmission and distribution (T & D) lines are calculated based on two different corona models. Three different sources of excitation of the lines are considered, which include a HEMP plane wave, a localized voltage source, and a current injected at a point on the wire. The induced current and charge are calculated and compared with some available experimental data and with the results of Baum's model. The results illustrate that the corona generally reduces the peak value of the induced current as much as 30% of the value and decreases the rate of rise by about 40%. The HEMP-induced stresses across dielectric insulators in some typical electric power systems are also calculated. The insulators that are considered are line supports in T & D line poles, and transformer bushings in distribution and power transformers. Different elevation and azimuthal angles of HEMP incidence with two different values of ground conductivity are considered. The HEMP-induced "potential difference" across the line support and air gap in the transmission lines and the HEMP-induced open-circuit voltage across transformer bushings are calculated. The "potential difference" across the line support and across the air gap can be as high as 7 MV. The rise time of the "potential difference" is about 110 ns, and the fall time is about 2 to 3 μs. The open-circuit voltage across transformer bushings can be as large as few tens of MVs and the rise time is in the order of 100 ns and the fall time 800 ns.

1279 **(ORNL/Sub—84-73986/2) HEMP interaction with an electric power distribution circuit. Final report.** Zaininger, H.W.; Jaszewski, G.M. (Zaininger Engineering Co., San Jose, CA (USA)). Aug 1985. Contract AC05-84OR21400. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001442.

A high altitude nuclear burst, detonated at a height of 50 km or more, causes two types of electromagnetic pulses, high altitude EMP (HEMP) and magnetohydrodynamic EMP, which will interact with electric power systems. Previous work indicated that millions of miles of electric distribution systems in the United States may be especially vulnerable to HEMP incident simultaneously throughout large portions of the United States. Purpose of this work was to perform an initial assessment of HEMP induced surges on a simplified electric distribution system. This report presents the assumptions, methodology, and resulting induced transient voltages and currents at various points in the distribution circuit in the microsecond timeframe, considering the impacts of HEMP incident simultaneously throughout the distribution system for a range of parametric conditions. Results of this work suggest that EMP could induce voltage transients that far exceed the basic insulation level (BIL) of distribution systems and that a more detailed analysis is warranted.

1280 **(UCRL—92419) Formation of sinks above underground cavities in NTS alluvium.** Thigpen, L.; Rambo, J.T. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 38p. (CONF-850953—10). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001573.

From 3. symposium on containment of underground nuclear explosions; Idaho Falls, ID, USA (10 Sep 1985).

The collapse of the AGRINI cavity initiated a Programmatic effort to study the collapse of underground cavities and the formation of collapse craters or sinks at the Nevada Test Site (NTS). Computer calculations are performed to study conditions prior to collapse of the strata above the cavity. A calculation with viscoelastic material response shows that a tensile stress region develops in the material above the cavity on unloading the cavity pressure. This suggests a mechanism for cavity collapse. One application of this research is to aid in the evaluation of potential sites for location of underground nuclear tests. 13 refs., 22 figs., 3 tabs.

1281 **(UCRL—93326) Real-time monitoring of pre-collapse phenomena using locations of seismic sources.** Jarpe, S.P.; Burkhard, N.R. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 13p. (CONF-850953—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001649.

From 3. symposium on containment of underground nuclear explosions; Idaho Falls, ID, USA (10 Sep 1985).

We attempted to develop a method for real-time monitoring of pre-collapse activity in the cavity region using seismic trace data recorded following EGMONT. Signals from an array of eight three-component, short-period seismometer stations were recorded using a new high dynamic range, portable digital telemetry and recording system. Three stations were located at 1 DOB, three at 2 DOB, and two at 4 DOB. Seismic data were recorded continuously before, during, and after collapse. As has been reported by previous studies, the pre-collapse period was characterized by a continuous high level of activity, but unlike previous studies, the recording system was not saturated, which allowed us to attempt to process the information. We discovered that all of the signals at a given location are very similar, but that the character is very different at the separate locations. A variety of computer processing techniques were attempted with the aim of obtaining source locations accurately enough to monitor chimney growth, i.e., +-50m both horizontally and vertically. These included the traditional methods of picking arrival times of phases at the different stations and using the time differences to locate the source, as well as more unusual approaches. We concluded that an array of sensors such as that used for EGMONT will not produce satisfactory results with real-time processing. We did, however, come up with an approach using several small, closely-spaced groups of sensors called arrays that should be more successful for this type of situation. The arrays, if designed properly, will take advantage of the similarity of the sig-

nals at a given location to estimate source direction. The directions from several arrays to one source can be combined to determine the source location. 2 refs., 6 figs.

1282 **(UCRL—93405) Evidence for syntectonic activity during alluvial deposition, Yucca Flat, Nevada.** Elwood, R.; McKague, H.L.; Wagoner, J. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 21p. (CONF-850953—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001650.

From 3. symposium on containment of underground nuclear explosions; Idaho Falls, ID, USA (10 Sep 1985).

Downhole movies in four large diameter drillholes show a shallowing of bedding dip with increasing distance above the alluvium-tuff contact. The holes are located on the downthrown side of an east dipping normal fault. In each hole the dip of the strata decreases from 20° to 30° at total depth to nearly horizontal at a depth of 150 to 200m. From this depth to the surface the bedding is nearly (<5°) horizontal. In emplacement hole U4ar, the alluvial section is divided into 5 stratigraphic units. The three lowest units have a specific range of bedding attitude. The upper two units occur in the same zone of horizontal dip. The borehole film of U4ar as well as a dipmeter log from exploratory hole UE4ah, indicates the attitudes of the volcanic tuff beds below the alluvium-tuff contact are the same as those of the basal alluvial unit. The conformable contact suggests that block rotation and thus fault displacement began after the initial alluvial deposition. Contemporaneous sedimentation and deformation continued until the sediments now at about 150 m depth were deposited. At this time, the fault activity decreased significantly. The uphole decrease in dip is consistent with block rotation along a listric fault. A seismic reflection survey through the area supports the proposed listric nature of the fault. Similar growth faults in the Gulf Coast result from contemporaneous sediment deposition and deformation. However, at the NTS the faults are a result of tectonic processes rather than sedimentary loading. 6 refs., 13 figs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 582

1283 **(LA-UR—85-2745) Monte Carlo simulation of two-particle relative diffusion using Eulerian statistics.** Lee, J.T.; Stone, G.L.; Lawson, R.E. Jr.; Shipman, M. (Los Alamos National Lab., NM (USA); Environmental Protection Agency, Research Triangle Park, NC (USA); Northrop Services, Inc., Research Triangle Park, NC (USA)). 1985. Contract W-7405-ENG-36. 16p. (CONF-851177—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85015727.

From 7. symposium on turbulence and diffusion of the AMS; Boulder, CO, USA (12 Nov 1985).

One-particle Monte Carlo simulations of relative diffusion in LSa are modified to account for interparticle velocity correlations both at the source and along the particle trajectories. The interparticle correlations are calculated directly from the Eulerian space-time velocity autocorrelation function. Since the particle trajectories are coupled, this is referred to as a two-particle model. Results from these two-particle simulations are compared to our previous one-particle results to determine the importance of the interparticle correlations downwind of the source. The models are evaluated by comparison with new wind tunnel data on the absolute diffusion and meandering of a plume in a field of grid-generated turbulence.

1284 **(UCID—20557) Simple trajectory model using meteorological data on an irregular grid.** Walton, J.J. (Lawrence Livermore National Lab., CA (USA)). Aug 1985. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001688.

A simple trajectory model has been developed that uses wind and temperature observations on an irregular grid. No diffusion calculation is performed but a number of parcels, injected at different locations and heights can be followed. The present version of the code has been driven using data from the NAMER-WINDTEMP tapes.

1285 **(USGS-BULL—1634) Remote monitoring of processes that shape desert surfaces: the desert winds project.** McCauley, J.F.; Breed, C.S.; Helm, P.J.; Billingsley, G.H.; MacKinnon, D.J.; Grolier, M.J.; McCauley, C.K. (Geological Survey, Reston, VA (USA)). 1984. 23p. US Geological Survey, 604 South Pickett St., Alexandria, VA 22304. File Number TI86900108.

Investigations of wind as a geologic agent have been hampered by a scarcity of long-term onsite measurements of wind velocity (including peak gusts, direction, and periodicity), precipitation frequency and intensity, relative humidity, and soil and air temperatures in key desert localities. This report describes a new long-term study, using data obtained by meteorologic and geologic sensors coupled to nonattended solar-powered data-collection platforms. Data obtained from these geometeorologic ("Geomet") stations in type desert areas of Arizona are automatically relayed by the Geostationary Operational Environmental Satellite (GOES) to the US Geological Survey in Flagstaff, Arizona, in real time, and converted to graphic form. Preliminary computer analysis of the data indicates strikingly different meteorologic patterns that control, in great part, the local surficial geology of different desert areas. 28 refs., 14 figs.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 52, 56, 59, 67, 84, 85, 105, 106, 462, 463, 480, 854, 1013, 1271, 1318, 1343, 1359, 1402, 1404, 1406, 1450, 1460, 1468

1286 **(AD-A—155441/9/XAB) Emergency modeling of hazardous air pollutants. Final report, June 1983-September 1984.** Hebets, M. (Radian Corp., Austin, TX (USA)). May 1985. 246p. NTIS, PC A11/MF A01.

An updated atmospheric diffusion modeling capability was developed for responding to accidents that emit toxic vapors into the atmosphere. The microcomputer-based Complex Hazardous Air Release Model (CHARM) was adapted for use in Air Force propellant, fuel, and chemical handling operations. Air Force personnel can use the model to assess potential exposure to airborne toxic clouds resulting from an emergency or accidental release of hazardous compounds. CHARM includes proven evaporation and atmospheric dispersion algorithms and includes a procedure for modeling the dispersion of denser-than-air gases.

1287 **(AD-P—004752/2/XAB) Eco-kinetic model for the accumulation of PCB (polychlorinated biphenyl) in marine fishes.** O'Corror, J.M.; Pizza, J.C. (Corps of Engineers, Fort Belvoir, VA (USA). Water Resources Center). Nov 1982. 19p. NTIS, PC A02/MF A01.

The authors empirical and modeling data have direct application to ongoing ocean dumping studies: (1) The hypothesis that PCB burden in fishes is strongly related to diet renders the mass loading approach to ocean PCB pollution ineffective in estimating contaminant levels in fish. Both dredged material and sewage sludge must be evaluated more carefully to assess real quantities of PCBs injected into the food chain and the water column. (2) The pharmacokinetics of PCBs in fishes suggest that any isolation of contaminated materials from entry to the food chain wil have the effect of lowering PCB body burdens in the large, predatory species which often form an important part of the human diet. Thus, maintaining a surficial layer of sediments with low or nonavailable PCBs will, in all likelihood, result in a trend toward lower body burdens in all trophic levels. (3) The overall outcome of the model suggests that we shall not see increased PCB levels in fishes if input rates and input sources remain similar to those of recent years.

1288 **(CONF-850944—3) Estimation of source-receptor matrices for deposition of nitrate.** Shannon, J.D.; Lesht, B.M. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001796.

From Muskoka conference: international symposium on acidic precipitation; Toronto, Ontario, Canada (15 Sep 1985).

Using the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model, regional-scale transport and deposition reactions involving NO and NO_2 were approximated with a linear, irreversible rate of transformation of combined NO/NO_2 to an imprecisely defined NO_3^- species, which combines both nitric acid and particulate nitrate.

1289 **(DOE/ER/60292—1) Operation and research at the Ithaca MAP3S regional precipitation chemistry site. Progress report, 1 December 1984-1 August 1985.** Likens, G.E.; Butler, T.J. (New York Botanical Garden, NY (USA). Inst. of Ecosystem Studies; Cornell Univ., Ithaca, NY (USA)). Aug 1985. Contract FG02-85ER60292. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001847.

The site continues to operate smoothly as it has since September 1976. Data for 1 June 1984-31 July 1985 show generally average meteorologic conditions and acidic precipitation at the site in terms of event number (88), precipitation amount (90 cm), H^+ concentration (72.4 μeq/1 or pH 4.14), and H^+ deposition (653 eq/ha). Network related research includes evaluation of differences in mean pH among sites. Ithaca, Penn State, and Virginia have lowest mean pH's (4.17) followed by Oxford and Oak Ridge (4.28). The peripheral sites Whiteface, Illinois, Brookhaven, and Lewes have significantly higher mean pH's, ranging from 0.1 to 0.3 pH units (13 to 30 μeq H^+/1) higher than Ithaca. Comparisons of precipitation chemistry data show no negative correlation between H^+ and Ca^{2+}, contrary to what has been suggested in the literature. There are positive correlations between H^+ and SO_4/sup =/, and H^+ and NO_3^- at all sites. Research on particle mineralogy so far suggests that common crustal minerals (iron oxides, silicon dioxide, muscovite mica and clays) dominate as well as sulphur-rich and calcium species. Calcium sulphate appears to be more abundant than calcium carbonate even though calcium carbonate is more abundant in soils over most of the US. It is proposed that $CaSO_4$ aerosol is being formed through the neutralization of $CaCO_3$ particles by H_2SO_4 aerosols ($CaCO_3 + H_2SO_4 + 2\ H_2O \rightarrow CaSO_4 + H_2O + CO_2$). 6 refs., 4 tabs.

1290 **(IVL-B—746) Measurements of nitrous acid in the city of Gothenburg.** Sjoedin, Aa.; Ferm, M.; Grennfelt, P. (Institutet foer Vatten- och Luftvaardsforskning, Stockholm (Sweden)). Jan 1984. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752729.

Atmospheric concentrations of nitrous acid were measured during a five month period in central Gothenburg. Samples of HNO_2 were collected in 12-hrs intervals by means of an impregnated denuder technique. The sampling was followed by colorimetric analysis with respect to nitrite ions. During the period January to May values in the range of approximately 1 to 50 nmole/m^3 were observed. Simultaneous measurements of NO, NO_2 and H_2O show that observed nighttime HNO_2 is approximately 10-15% of calculated equilibrium concentrations, while the daytime fraction is markedly lower. This indicates that HNO_2 is decomposed to OH-radicals during daytmie by daylight photolysis. Correlation coefficient calculatins for ambient HNO_2 and NO-, NO_2- and water vapor concentrations reveal that the thermal reaction No + NO_2 + H_2O -> $2HNO_2$ is the major source of nitrous acid at night.

1291 **(IVL-B—754) Emission into air and deposition of alkaline substances in Sweden 1950-1980.** Loevblad, G. (Institutet for Vatten- och Luftvaardsforskning, Goeteburg). May 1984. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752735.

The emission has been estimated for industrial processes and energy production. There is a reduction by a factor of 10 during the period. The diffuse emission of alkaline substances has not been quantified. Wet deposition of calcium is also decreasing. The total deposition of calcium seems to have gone down by approximately 100,000 tons per year. Even when the point source emissions were large in the fifties they had no critical importance of neutralizing acid precipitation.

1292 **(PB—85-212058/XAB) Assessment of precipitation-chemistry measurements from the Global Trends Network and its predecessors (1972-1982).** Dayan, U.; Yoshinaga, A.M.; Nelson, D.W.; Miller, J.M. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Apr 1985. 132p. (NOAA-TM-ERL-ARL—136). NTIS, PC A07/MF A01.

The Global Trends Network (GTN) consists of two parts: (1) the routine stations operated directly by NOAA, which are considered a part of the WMO baseline network; and (2) the research network, which is part of the Global Precipitation Chemistry Project directed by the University of Virginia. The precipitation chemistry measurements from the GTN and its predecessors are presented and analyzed. Evaluation of the GTN baseline sites is emphasized. Siting criteria, network operations, sampling periods, collection techniques, and analytical procedures are discussed in detail. Annual and monthly volume weighted means, medians, and standard deviations of the data are included. Also selected plots of the annual concentrations of H^+, non-seasalt SO_4^{-2}, and NO_3^- are depicted and discussed. Among the important conclusions from this study are the following: a great improvement has been made in the baseline data with the introduction of weekly sampling in 1980; no obvious trends can be detected in the 10-year record; and the average hydrogen ion concentration is about pH 5.0 in remote areas. For certain individual events this can be much lower, and the sulfate values in remote locations are about 10 times less than those found in polluted areas.

1293 **(PB—85-212959/XAB) Analysis and assessment of US-WMO regional precipitation-chemistry measurements (1972-1982): a subset of the National Trends Network. Technical memo.** Artz, R.S.; Miller, J.M. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Air Resources Labs.). Feb 1985. 274p. (NOAA-TM-ERL-ARL—135). NTIS, PC A12/MF A01.

Data from the entire sampling period (1972-1982) for all sites in the National Trends Network and its predecessors are presented. Annual and monthly (where appropriate) volume-weighted means, medians, and standard deviations are included. Selected graphs of annual statistics are also shown. Analysis of these data indicates improvement in data quality since 1980 for all ions measured and at all sites. Post-1980 data are of high quality, well-documented, and should be useful for most studies requiring a regional data base. Pre-1980 data are of lesser quality and not sufficiently accurate for seasonal evaluation or annual trend analysis.

1294 **(PB—85-216976/XAB) Effects of acidity on tree Pollen germination and tube growth. Final report.** Van Ryn, D.M.; Jacobson, J.S. (Cornell Univ., Ithaca, NY (USA). Dept. of Natural Resources; Boyce Thompson Inst. for Plant Research, Ithaca, NY (USA)). Aug 1984. 27p. NTIS, PC A03/MF A01.

Most of the northeastern hardwood forests in North America are exposed repeatedly to acidic rainfall at pH values below 5.0. Pollen germination, tube growth and fertilization, important parts of the reproductive process, are sensitive to changes in their chemical environment. Accordingly, the authors investigated the effects of acidity on pollen germination and tube elongation of four northeastern tree species: flowering dogwood, black birch, yellow birch, and sugar maple. Pollen was collected and germinated in a growth medium acidified to pH values ranging from 5.0 to 2.6. Pollen was found to be sensitive to acidification of the germination medium to below pH 4.2. These results suggest that acidic rain that now occurs in eastern North America may influence reproductive processes that are necessary for seed set and regeneration in northern hardwood forests.

1295 **(PB—85-218204/XAB) Statistical analysis of daily London mortality and associated weather and pollution effects. Final report.** Shumway, R.H.; Tai, R.Y.; Tai, L.P.; Pawitan, Y. (California Univ., Irvine (USA)). Dec 1983. 56p. NTIS, PC A04.

The possible association between daily overall, respiratory, and cardiovascular mortality and several daily pollution and weather variables was investigated using general multiple time-series fre-

quency-domain regression models on data from fourteen London winters, 1958-1971. The best model for predicting overall cardiovascular or respiratory mortality involved temperature and the logarithms of the levels of either sulfur dioxide or particulates (British smoke). The effects of the two pollutants were essentially indistinquishable. Relative humidity had no significant effect. Pollution is more important than temperature for predicting changes in overall respiratory mortality but less important for predicting cardiovascular mortality. Judging by significant coefficients in the regression analysis, pollution acts positively on same-day mortality. In contrast, temperature acts positively on same-day overall and cardiovascular mortality and temperature lagged by two days acts negatively on all measures of mortality. The strongest frequency-domain association, as measured by the multiple coherence, occur at periods ranging between seven and twenty-one days.

1296 **(PB—85-220796/XAB) In-depth survey report CT-144-21A, Macawber Engineering, Inc., Maryville, Tennessee.** Heitbrink, W.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 13 Aug 1984. 38p. (CT—114-21A). NTIS, PC A03/MF A01.

An in-depth survey of control technology for reducing limestone exposure during bag-opening operations at Macawber Engineering, Incorporated (SIC-3535), Maryville, Tennessee was conducted in April, 1984. The ability of an automatic bag slitter to open bags of very fine limestone (mass median diameter less than 4.0 micrometers) without becoming a dust-emission source was evaluated. Total and respirable dust concentrations before and during bag-slitting operations were measured under the bag-disposal chute, above the bag-disposal tube, at the outlet of the automatic unbagger, next to the bellows, or at a position next to the storage bins. The author suggests that the bag slitter leaks dust. As tested, the automatic bag-opening machine is probably suitable only for handling relatively nontoxic dusts.

1297 **(PB—85-221547/XAB) Selected occupational-health-hazard controls in the incineration of hazardous wastes.** Anastas, M.Y. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). Sep 1984. 83p. (CT—103-04). NTIS, PC A05/MF A01.

Surveys of control technology in the hazardous-waste incineration industry (SIC-4953) were conducted. Twelve walkthrough and four in-depth surveys were conducted. State-of-the-art engineering controls existed at three facilities. At these facilities, liquid wastes in 55 gallon drums were dumped automatically into hoppers enclosed within ventilated booths. Bulk liquids received in tank trailers or 600-gallon dumpsters were connected by electrically grounded transfer hoses to the furnace or to storage tanks. The trailers were vented to spot (local) scrubbing systems, and explosive proof pumps were used. Solids, sludges, and sample bottles were handled by an automated pack and drum-feed system or by a loader. General ventilation, 12 to 15 changes per hour, was provided. The facilities provided employee training in health hazards and safety. Good-work practices such as using appropriate personal-protective equipment and safety belts and chutes around kiln openings were observed. Concentrations of low-to-medium toxicity materials were between 1 and 15% of their threshold-limit values. The author notes that at some facilities respiratory protection was used as an added precaution when handling highly toxic wastes, although the engineering controls alone were sufficient to meet the exposure standard.

1298 **(PB—85-227759/XAB) Review of sampling and analysis methodology for polynuclear aromatic compounds in air from mobile sources. Final report, 1 March-30 November 1983.** Chuang, C.C.; Petersen, B.A. (Battelle Columbus Labs., OH (USA)). Jun 1985. 68p. NTIS, PC A04/MF A01.

The objective of the program was to review and recommend test compounds and sampling and analysis methods for a future EPA study of polynuclear aromatic hydrocarbons (PAH) in microenvironments. Review of PAH profiles in ambient air indicated that concentrations of PAH were generally higher in winter than summer and varied with climate and between sampling sites within an urban area. Levels of several PAH were found to be proportional to traffic density. Studies of the biological activity of ambient air samples showed that some PAH and their nitrated derivatives are extremely carcinogenic and mutagenic. The following compounds were determined to be the most prevalent and mutagenic in ambient air and were recommended for the future EPA study: phenanthrene, pyrene, cyclopenta(c,d)pyrene, benzo(a)pyrene, dibenz(a,h)anthracene, 1-nitropyrene, fluoranthene, benz(a)anthracene, benzo(e)pyrene, benzo(g,h,i)perylene, coronene, and 3-nitrofluoranthene. In the review of PAH sampling methods, collection of both gaseous and particulate bound PAH was determined to be necessary to accurately characterize health effects of PAH in ambient air. Most studies have used filters to sample particulate-bound PAH and absorbents to collect vapor phase PAH. The major sampling problems encountered in the studies were PAH losses due to volatilization and reactivity.

1299 **(PB—85-233393/XAB) Acidic-Deposition Phenomenon and Its Effects: Critical Assessment Document. Final report.** Bennett, D.A.; Goble, R.L.; Linthurst, R.A. (Environmental Protection Agency, Washington, DC (USA). Office of Acid Deposition, Environmental Monitoring, and Quality Assurance). Aug 1985. 182p. (EPA/600/8—85/001). NTIS, PC A09/MF A01.

The Acidic-Deposition Phenomenon and Its Effects: Critical Assessment Document (CAD) is a summary, integration, and interpretation of the current scientific understanding of acidic deposition. It is firmly based upon The Acidic Deposition Phenomenon and Its Effects: Critical Assessment Review Papers (CARP), PB85-100030 and PB85-100048, a multi-authored comprehensive critical review of the published scientific literature of the atmospheric phenomena and effects of acidic deposition, augmented by additional current scientific references. The authors of this integrative summary attempted to draw together and interpret evidence from disparate sections of the CARP. Reference is made, where possible, to CARP sections providing information for the CAD analyses; citations are made to additional references. Quotations and paraphrases of conclusions and observations from the CARP provide much of the material in the CAD. As such, they represent the conclusions of the CARP authors interpreted by the CAD authors. Some additional evidence has been developed by the CAD authors, and the conclusions drawn from this information are solely those of the CAD authors.

1300 **(PB—231535) Haze formation: its nature and origin 1973.** Miller, D.F.; Schwartz, W.E.; Jones, P.W.; Joseph, D.W.; Spicer, C.W.; Riggle, C.J.; Levy, A. (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Jun 1973. 178p. (EPA—650/3-74-002). NTIS.

The objective of this project is to identify and analyze atmospheric haze in order to distinguish between photochemical haze from automotive sources and that from nonautomotive sources. Historically, very little is known regarding the composition of atmospheric aerosols, particularly the composition of the organic constituency - an area where photochemical processes prevail in creating light-scattering aerosols. This program, currently in its second year at Battelle-Columbus, has been devoted to characterizing the composition of aerosols by adaptations of analytical techniques to microquantities and to the retrieval of detailed air-quality data simultaneously with aerosol collections. The report summarizes the results of research done in the period June 6, 1972, to June 6, 1973. In consultation with the CAPA-6 project group, it was decided that the report contain a description of experimental methods, a complete presentation of experimental data, and a brief discussion of experimental findings, with no attempt being made to establish cause-effect relationships.

1301 **(TVA/OP/EDT—84/13) Economics of nitrogen oxides, sulfur oxides, and ash control systems for coal-fired utility power plants.** Maxwell, J.D.; Humphries, L.R. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Feb 1985. 303p. (EPA—600/7-85-006). NTIS, PC A14/MF A01. File Number DE86900097.

A US Environmental Protection Agency (EPA)-sponsored economic evaluation was made of three process combinations to reduce NO/sub x/, SO_2, and ash emissions from coal-fired utility power plants. One case is based on a 3.5% eastern bituminous coal; the other two are based on 0.7% western subbituminous coal. NO/sub x/ control is based on an 80% reduction from current new source performance standards (NSPS); SO_2 and fly ash control are based on meeting the current NSPS. Selective catalytic reduction (SCR) is used for NO/sub x/ control in all three cases. Limestone scrubbing and a cold-side electrostatic precipitator (ESP) are used in the 3.5% sulfur coal case. Lime spray dryer flue gas desulfurization (FGD) and a baghouse for particulate collection are used in one 0.7% sulfur coal case; limestone scrubbing and a hot-side ESP are used in the other. The economics consist of detailed breakdowns of the capital investments and annual revenue requirements. For systems based on a 500-MW power plant, capital investments range from $167 to $187 million (333 to 373 $/kW) and first-year annual revenue requirements from $54 to $60 million (29 to 33 mills/kWh). The 3.5% sulfur coal case is highest because of the higher SO_2 control costs. The case with the spray dryer and baghouse is marginally lower in cost than the case with limestone scrubbing and hot-side ESP. Costs for NO/sub x/ control range from one-fourth to one-half of the total costs, largely because of the high cost of the catalyst. The costs of the overall systems and the relationships of the component costs are complexly interrelated because of the interactions of the three processes.

1302 **Changing climate and energy modeling: a review.** Reilly, J.; Edmonds, J. (Oak Ridge Associated Universities, TN). *Energy Journal;* **6**: No. 3, 137-154(Jul 1985).

A review of a 1983 National Academy of Sciences report on the greenhouse effect focuses on the link between energy and carbon dioxide (CO_2) emissions, which is examined in Chapter 2 of the report. While in substantial agreement with the major qualitative conclusions and appreciative of the literature review, the authors note a bias toward low carbon emissions in the year 2000 in the model structure. They suggest introducing some process model characteristics, such as conversion processes. They also note the need to broaden research to other atmospheric constituents with potential to effect climatic change. 24 references.

1303 **Spectral fingerprinting of polycyclic aromatic hydrocarbons in high-volume ambient air samples by constant energy synchronous luminescence spectroscopy.** Kerkhoff, M.J.; Lee, T.M.; Allen, E.R.; Lundgren, D.A.; Winefordner, J.D. (Univ. of Florida, Gainesville). *Environmental Science and Technology;* **19**: No. 8, 695-699(1985).

A high-volume sampler fitted with a glass-fiber filter and backed by polyurethane foam (PUF) was employed to collect airborne particulate and gas-phase polycyclic aromatic hydrocarbons (PAHs) in ambient air. Samples were collected from four sources representing a range of environmental conditions: gasoline engine exhaust, diesel engine exhaust, air near a heavily traveled interstate site, and air from a moderately polluted urban site. Spectral fingerprints of the unseparated particulate and gas-phase samples were obtained by constant energy synchronous luminescence spectroscopy (CESLS). Five major PAHs in the gas-phase extracts were characterized and estimated. The compatibility of a high-volume sampling method using polyurethane foam coupled with CESLS detection is explored for use as a screening technique for PAHs in ambient air.

1304 **Development of an indoor multihazard monitor I. carbon monoxide.** Altpeter, L.L. Jr.; Rupich, M.W.; Holleck, G.L.; Makrides, A.C.; Kruse, J.R.; Kebabian, P.L.; Venkatasetty, H.V. (Gas Research Inst.). pp 1088-1097 of International Gas Research Conference - 1984. Rockville, MD; Government Institutes, Inc. (1985). (CONF-840903—).

From International gas research conference; Washington, DC, USA (10 Sep 1984).

The feasibility of detecting carbon monoxide in the 10-1000+ ppm range has been successfully demonstrated by two techniques, each of which may lead to a compact device for field monitoring. An electrochemical technique, based on the oxidation of carbon monoxide to carbon dioxide, has shown adequate sensitivity, selectivity and freedom from interferences. Initial lifetime tests show a lifetime of at least one year of continuous service. A nondispersive infrared technique (NDIR) achieved measurement of carbon monoxide in the air by means of a unique fluorescence tube containing a mixture of carbon monoxide and activator substances. When the tube was irradiated with ultraviolet radiation, the result was an infrared fluorescence of the 4.6 um CO band. Carbon monoxide in the air was selectively and sensitively measured by this NDIR technique.

1305 **Characteristics of atmospheric ions in contrasting environments.** Wilkening, M. (New Mexico Institute of Mining and Technology, Socorro). *International Conference on Atmospheric Electricity;* 54-56(1984). (CONF-840668—). Contract AC04-82ER60095.

From 7. conference on atmospheric electricity; Albany, NY, USA (4 Jun 1984).

The general nature of atmospheric small ions with mobilities in the approximate range of 1-2 x 10^{-4} m^2/Vs has been known for many decades. In this study changes in ion-pair production rates, ion density, mobility, and polar conductivity have been observed in contrasting environments with the results that new light is shed on the properties of these ions which play such an important role in atmospheric electricity. ^{222}Rn, ^{220}Rn and their daughter products are the chief ionizing agents in the lower layers of the atmosphere exceeding that due to cosmic rays and radioactive substances in the ground. A single alpha particle from the decay of ^{222}Rn will produce about 150,000 ion pairs. It is important, therefore, to give careful consideration to the role of these natural radioactive nuclides when investigating the characteristics of atmospheric ions. Over a period of years studies of the behavior of positive and negative small ions have been made in outdoor environments at a mountain location, in the Rio Grande Valley at Socorro, New Mexico and in the Carlsbad Caverns. These sites provided wide variation in ion-pair production rates, water vapor mixing ratios, and condensation nuclei concentrations against which the atmospheric electrical characteristics could be measured and analyzed. The role of the radon-daughter ions in storm and fair weather conditions at the Langmuir Laboratory has been treated previously. 16 references, 2 tables.

1306 **Methods for reliable pH measurements of precipitation samples.** Sisterson, D.L.; Wurfel, B.E. (Argonne National Lab., IL). *International Journal of Environmental Analytical Chemistry;* **18**: 143-165(1984).

Significant errors in precipitation acidity determinations can result from improper use of pH electrodes. Conventional electrodes measure free hydrogen ion activity instead of hydrogen ion concentration or free acidity. Correction from activity to concentration is a function of ionic strength and can be large for the low ionic strengths typical of precipitation samples. Also, differences between sample and standard calibration buffer solution ionic strengths can result in liquid-junction potentials that affect electrode readings. Streaming potentials due to the stirring of precipitation samples can cause the single, largest error in pH. Certain procedures can be employed to reduce individual types of errors. These and methods to assess pH electrode performance are discussed.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 212, 219, 495, 1342

1307 **(CEA-CONF—7661) Assessment of the dispersion of fission products in the atmosphere following a reactor accident under meteorological conditions of low wind speed.** Crabol, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1984. 12p. (CONF-8410331—2; DAS—105). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752832.

From Seminar on the results of the indirect action research program: safety of thermal water reactor; Brussels, Belgium (1 Oct 1984).

The aim of the study is the assessment of the dispersion in a low speed situation and the validation of the computer code ICAIR3 by means of SF6 tracing experiments carried out on the CADARACHE site under different stability conditions. The results

show clearly some characteristic features of the dispersion. In particular, high concentrations are found in the experimental field several hours after the end of the release. Large differences of the plume width are observed depending on the atmospheric stability. The flow seems well organized under stable conditions, probably in relation with a topographic effect (CADARACHE is situated in a valley), while there is a much larger spread out of the plume in neutral or unstable conditions. A reasonable agreement with the values predicted by the calculation code is found for the maximum concentration.

1308 **(DPST—85-552) Radiological effect on SRP operations - 1984.** Marter, W.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 12 Jun 1985. Contract AC09-76SR00001. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001968.

Environmental doses were calculated for Savannah River Plant releases of radioactivity in 1984. Maximum offsite individual (child) and population doses from atmospheric releases increased 25% and 30%, respectively, over those in 1983. The increase was largely due to a 28% increase in the atmospheric release of tritium in 1984. Maximum offsite individual (adult) doses from liquid releases increased 100%, largely from a 57% increase in the release of Cs-137 and uptake via the fish pathway. Population doses from liquid releases declined about 6% even though river flow (and dilution) was about the same in 1984 as in 1983. This decrease was the result of a 3% decrease in the release of tritium and an apparent greater dilution of Beaufort-Jasper and Port Wentworth drinking water with surface waters from sources other than the river. The release of tritium to the atmosphere is of special interest because it contributes 97% of the offsite population dose. The 28% increase in release in 1984 represents 25.3 person-rem to the 80-km-radius population. The increase in separations releases resulted from above normal tritium releases during normal operations, storage of tritium-contaminated materials in non-leakproof containers, and unplanned releases during March (7500 Ci) and September (57,900 Ci). 2 refs., 9 figs., 14 tabs.

1309 **(KFK—3936) First atmospheric diffusion experiment campaign at the Angra site - measured data.** Biagio, R.; Godoy, J.; Nicoli, I.; Nicolli, D.; Thomas, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Meteorologie und Klimaforschung; Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). Jun 1985. 49p. (CNEN—1201). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752715.

Results of the first five atmospheric diffusion experiments conducted at the NPP Angra 1 site, from November 28 to December 4, 1984, are presented. The Angra 1 site is characterized by complex terrain with steep hills near to the sea coast. Tritiated water vapor (HTO) eas used as a tracer and released from the top of a 100 m high tower. Water moisture was then collected downwind at 25 positions where three consecutive samplings were effected, each covering a period of 30 min of exposition. During the experiments meteorological data were obtained on four towers. Temperature and air humidity were additionally measured at some sampling points.

1310 **(LBL—19346) Indoor concentrations of radon 222 and its daughters: sources, range, and environmental influences.** Nero, A.V. Jr. (Lawrence Berkeley Lab., CA (USA)). Apr 1985. Contract AC03-76SF00098. 27p. (CONF-8410136—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE86000615.

From 7. ORNL life sciences symposium on indoor-air and human health: major indoor air pollutant and their health implications; Knoxville, TN, USA (29 Oct 1984).

The author here reviews what is presently known about factors affecting indoor concentrations of radon 222 and its daughters. In US single-family homes, radon concentrations are found to average about 1.5 pCi/l, but substantially higher concentrations occur frequently: perhaps a million US homes have concentrations exceeding 8 pCi/l (from which occupants receive radiation doses comparable to those now experienced by uranium miners). The major contributor to indoor radon is ordinary soil underlying homes, with this radon being transported indoors primarily by the slight depressurization that occurs toward the bottom of a house interior (due to indoor-outdoor temperature differences and winds). Water from underground sources contributes significantly in a minority of cases, primarily residences with private wells, with public water supplies contributing only a few percent of indoor radon, even when drawn from wells. The strong variability in indoor concentrations is associated primarily with variability in the amount of radon entering homes from these various sources, and secondarily with differences in ventilation rates. However, for a given entry rate, the ventilation rate is the key determinant of indoor concentrations. Human doses are also influenced strongly by the chemical behavior of the daughters (i.e., decay products of radon), and considerable progress has been made recently in investigating a major aspect of this behavior, i.e., the manner in which daughters attach to airborne particles, to walls, and - indeed - to the lining of the lung itself, where the key radiation dose occurs.

1311 **(LBL—19726) Control of indoor radon and radon progeny concentrations.** Sextro, R.G. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 44p. (CONF-850606—16). NTIS, PC A03/MF A01; GPO Dep. File Number DE86000622.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

There are three general categories of techniques for the control of radon and radon progeny concentrations in indoor air - restriction of radon entry, reduction of indoor radon concentrations by ventilation or air cleaning, and removal of airborne radon progeny. The predominant radon entry process in most residences appears to be pressure driven flow of soil gas through cracks or other openings in the basement, slab, or subfloor. Sealing these openings or ventilation of the subslab or subfloor space are methods of reducing radon entry rates. Indoor radon concentrations may be reduced by increased ventilation. The use of charcoal filters for removal of radon gas in the indoor air by adsorption has also been proposed. Concentrations of radon progeny, which are responsible for most of the health risks associated with radon exposures, can be controlled by use of electrostatic or mechanical filtration. Air circulation can also reduce radon progeny concentrations in certain cases. This paper reviews the application and limitations of each of these control measures and discusses recent experimental results.

1312 **(NUREG—0837-Vol.5-No.2) NRC TLD Direct Radiation Monitoring Network. Volume 5, No. 2. Progress report, April-June 1985.** Jang, J.; Kramaric, M.; Cohen, L. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Sep 1985. 221p. NTIS, PC A10/MF A01 - GPO. File Number TI86900115.

The US Nuclear Regulatory Commission (NRC) Direct Radiation Monitoring Network provides continuous measurement of the ambient radiation levels around licensed NRC facilities, primarily power reactors. The Network is intended to measure radiation levels during routine facility operations and to establish background radiation levels used to assess the radiological impact of an unusual condition, such as an accident. This report presents the radiation levels measured around all facilities in the Network for the second quarter of 1985. A complete listing of the site facilities monitored is included.

1313 **(NUREG/CR—0150-Vol.3) Estimates of internal dose equivalent to 22 target organs for radionuclides occurring in routine releases from nuclear fuel-cycle facilities. Volume III.** Dunning, D.E. Jr.; Killough, G.G.; Bernard, S.R.; Pleasant, J.C.; Walsh, P.J. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract AC05-84OR21400. 84p. (ORNL/NUREG/TM—190/Vol.3). NTIS, PC A05/MF A01 - GPO. File Number TI86000924.

This report is the third of a three-volume tabulation of internal radiation dose conversion factors for man for radionuclides of interest in environmental assessments of nuclear fuel cycles. This volume provides an updated summary of estimates of committed dose equivalent for 142 radionuclides considered in the previous two reports. Intakes by inhalation and ingestion are considered. The International Commission on Radiological Protection (ICRP) Task Group Lung Model has been used to simulate the deposition

and retention of particulate matter in the respiratory tract. Results corresponding to activity median aerodynamic diameters (AMAD) of 0.3, 1.0, and 5.0 μm are given. The gatrointestinal (GI) tract has been represented by a four-segment catenary model with exponential transfer of radioactivity from one segment to the next. Retention of radionuclides in systemic organs is characterized by linear combinations of decaying exponential functions. Fifty-year dose commitment per microcurie intake of each parent nuclide is given for 22 target organs including contributions from specified source organs plus the systemic activity residing in the rest of the body; cross irradiation due to penetrating radiations has been incorporated into these estimates. A separate tabulation of effective dose equivalent for all 142 radionuclides is provided also; this quantity, as defined by ICRP Publication 26, provides an indication of the overall health risk resulting from a radionuclide exposure. 22 refs., 6 tabs.

1314 **(NUREG/CR—1151) Infiltration of particulate matter into buildings.** Cohen, A.F.; Cohen, B.L.; Aldrich, D.C. (Sandia National Labs., Albuquerque, NM (USA); Pittsburgh Univ., PA (USA)). Nov 1979. Contract AC04-76DP00789. 21p. (SAND—79-2079). NTIS, PC A02/MF A01 - GPO. File Number TI86000167.

The study was undertaken to estimate experimentally the protection afforded by being indoors against inhalation of particulates of outdoor origin. Results of the study suggest average protection factors (outdoor/indoor concentration ratio) for homes of approximately 4 for large (~5 micron) particles and 2 for submicron particles. Protection factors are somewhat higher for larger building types. As part of Sandia's FY 77-78 reactor accident emergency response planning program, a ventilation model was developed to estimate the potential effectiveness of sheltering in reducing the dose due to inhaled radionuclides. Use of "best estimate" values for the model parameters suggested a protection factor of 1.5. In light of the results obtained by Cohen, and the uncertainty of the particle size distribution resulting from a reactor accident, a protection factor of 2 can probably be assumed for sheltered individuals with some degree of conservatism.

1315 (OEVS-Mitteilung—2/85, pp 13-28) **Propagation of radioactive substances in the atmosphere.** Skoda, G. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780090. (CONF-8211212—).

From Fall meeting of the Austrian Study Group for Radioactivity Measurements in the Danube Region; Vienna, Austria (1 Nov 1982).

In this paper a review is given on the most important processes within the atmospheric circulation which have to be known when selecting an appropriate physico-mathematical model for calculating transport and diffusion of pollutants, e.g. of radioactive debris.

1316 **(SCPRI-RM—2-1985) Monthly results of measurements, February 1985.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Mar 1985. 29p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752882.

Measurement tables concerning the surveillance of the environment in France (see also the SCPRI-RT--1-1985 report).

1317 **(UCRL—92509) Computerized radiological emergency response and assessment system.** Sullivan, T.J.; Taylor, S.S. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 12p. (CONF-851117—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001576.

From International symposium on emergency planning and preparedness for nuclear facilities; Rome, Italy (4 Nov 1985).

The Department of Energy's Atmospheric Release Advisory Capability (ARAC) has been developed at the Lawrence Livermore National Laboratory to provide a centralized national capability in emergency response to radiological accidents. For the past three years the system has been undergoing a complete redesign and upgrade in software and hardware. Communications, geophysical databases, atmospheric transport and diffusion models, and experienced staff form the core of this rapid response capability. The ARAC system has been used to support US DOE commitments to provide emergency response and assessment of nuclear power plant, nuclear processing facility, transportation, satellite, weapon system, and other accidents or events. This paper describes the major components of this computerized system and discusses the automated and interactive process of the man-machine environment in an emergency response system. 12 refs., 2 figs.

5006 Regulations

REFER ALSO TO CITATION(S) 287, 766

1318 **(USGS-CIRC—964) Design of the national trends network for monitoring the chemistry of atmospheric precipitation.** Robertson, J.K.; Wilson, J.W. (Military Academy, West Point, NY (USA)). 1985. 51p. US Geological Survey, 604 S. Pickett Street, Alexandria, VA 22304. File Number TI85901879.

Long-term monitoring (10 years minimum) of the chemistry of wet deposition will be conducted at National Trends Network (NTN) sites across the United States. Precipitation samples will be collected at sites that represent broad regional characteristics. Design of the NTN considered four basic elements during construction of a model to distribute 50, 75, 100, 125 or 150 sites. The modeling oriented design was supplemented with guidance developed during the course of the site selection process. Ultimately, a network of 151 sites was proposed. The basic elements of the design are: assurance that all areas of the country are represented in the network on the basis of regional ecological properties (96 sites); placement of additional sites east of the Rocky Mountains to better define high deposition gradients (27 sites); placement of sites to assure that potentially sensitive regions are represented (15 sites); and placement of sites to allow for other considerations such as urban area effects (5 sites), intercomparison with Canada (3 sites), and apparent disparities in regional coverage (5 sites). Site selection stressed areas away from urban centers, large point sources, or ocean influences. Local factors, such as stable land ownership, nearby small emission sources (about 10 km), and close-by roads and fireplaces (about 0.5 km) were also considered. All proposed sites will be visited as part of the second phase of the study. 29 refs., 18 figs.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

1319 **(DOE/ER/60242—2) Vegetation analysis and mapping of the R4D research site. Progress report, July 1, 1984-September 30, 1985.** Walker, D.A.; Webber, P.J. (Colorado Univ., Boulder (USA). Inst. of Arctic and Alpine Research). 2 Oct 1985. Contract FG02-84ER60242. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001132.

This document contains a summary of progress to date regarding the vegetation analysis and mapping of the DOE R4D research site at Uyamitquaq Creek, northern Alaska. Accomplishments are divided into four broad categories: (1) plot location maps; (2) data collected from permanent vegetation study plots; (3) geobotanical mapping and geographic information system; and (4) preliminary vegetation and environmental gradient analysis. 8 refs., 3 figs., 6 tabs.

1320 **Carnus hemapterus nitzsch from Swainson's Hawk.** Fitzner, R.E.; Woodley, N.E. (Battelle, Pacific Northwest Lab., Richland, WA). *Raptor Research;* **17**: No. 1, 28-29([1985]).

The wingless ectoparasitic fly (Carnus hemapterus, Nitzsch) was first reported on North American birds by Bequaert (1942) although in Europe, C. hemapterus seems to be fairly generally distributed. Bequaert (1942) reports the C. hemapterus has been observed on 12 families and 26 species of birds in Europe. In July of 1980, while examining nestling Swainson's Hawks (Buteo swain-

soni), the authors found that 12 of the 15 nestlings studied were parasitized by C. hemapterus. The flies occurred in groups of 3 to 5 and were found only in the axillary region of the hawks. No flies were attached and on being disturbed they moved from the bare axillary region to nearby feathered areas. The exact nature of the diet of C. hemapterus is unknown. Noller (1920) reports that the fly sucks blood from its host, while Hendel (1928) felt that Carnus feeds most probably on skin secretions. They observed dried blood spots on the hawks axillary region which is supportive of Noller's (1920) claim. The true diet of the fly is presently in question, but the fly could act as a vector of certain avian blood parasites. These findings are of interest, since few records have been repoted for C. hemapterus in non-cavity nesting birds or from long-distance migrants like the Swainson's Hawk. This report is also the first record on this dipteran parasite on the Swainson's Hawk.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 175, 1038, 1289, 1291, 1323, 1336, 1339, 1359

1321 **(PB—85-214534/XAB) Acid precipitation: compositional changes during throughfall; soil water. Technical completion report.** Klein, R. (Wisconsin Univ., Madison (USA). Center for Limnology; Vermont Univ., Burlington (USA). Dept. of Botany). Dec 1984. 15p. NTIS, PC A02/MF A01.

Lysimeters were installed at two soil depths within each of the three major ecosystems on Camels Hump Mountain. Collections were made weekly during the frost-free season of 1982 and 1983. Samples were analyzed for pH, conductivity, and a broad range of metals, anionic and cationic constituents, and for other physical properties. The findings included: soil solutions obtained from the upper-elevations in a southern coniferous forest zone are significantly more acidic than those from the lower elevation hardwood forest zone; soil solutions for all ecological zones are more acidic in the spring during and shortly after snowmelt than they are later in the frost free-season; aluminum in soil solutions from the upper elevations is present in concentrations known to be phytotoxic to seedlings of forest trees and to groundcover plants; cadmium, Pb, and Zn are, in the spring, present in concentrations that are close to being phytotoxic; there are changes in the ratios of divalent cations to specific metals during the season and as functions of altitude and forest zones; nitrate concentration in soil water are also elevation- and time dependent.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 207, 209, 212, 213, 219, 222, 1038, 1308, 1312, 1314, 1316, 1434, 1481, 1496

1322 **(DOE/NV/10162—20) Nevada Test Site Radionuclide Inventory and Distribution Program: Report No. 2. Areas 2 and 4.** McArthur, R.D.; Kordas, J.F. (Nevada Univ., Las Vegas (USA). Water Resources Center; Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract AC08-81NV10162. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001456.

Radionuclide activity was measured by in situ spectrometry at 349 locations in Areas 2 and 4 of the Nevada Test Site. The data were analyzed by kriging and other methods to estimate the total inventory and distribution of six man-made radionuclides that were present in measurable amounts. Isotope ratios in soil samples were then used to infer the inventories of three other radionuclides. The estimated inventories were: ^{241}Am, 8 curies; ^{238}Pu, 18 curies; /sup 239,240/Pu, 51 curies; ^{60}Co, 7 curies; ^{137}Cs, 34 curies; ^{90}Sr, 71 curies; ^{152}Eu, 35 curies; ^{154}Eu, 6 curies; and ^{155}Eu, 3 curies.

1323 **(DP-MS—85-91) Savannah River Laboratory DOSTOMAN code: a compartmental pathways computer model of contaminant transport.** King, C.M.; Wilhite, E.L.; Root, R.W. Jr.; Fauth, D.J.; Routt, K.R.; Emslie, R.H.; Beckmeyer, R.R.; Fjeld, R.A.; Hutto, G.A.; Vandeven, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Clemson Univ., SC (USA). Dept. of Environmental Systems Engineering). 1985. Contract AC09-76SR00001. 36p. (CONF-8509121—13). NTIS, PC A03/MF A01; GPO Dep. File Number DE85018531.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

The Savannah River Laboratory DOSTOMAN code has been used since 1978 for environmental pathway analysis of potential migration of radionuclides and hazardous chemicals. The DOSTOMAN work is reviewed including a summary of historical use of compartmental models, the mathematical basis for the DOSTOMAN code, examples of exact analytical solutions for simple matrices, methods for numerical solution of complex matrices, and mathematical validation/calibration of the SRL code. The review includes the methodology for application to nuclear and hazardous chemical waste disposal, examples of use of the model in contaminant transport and pathway analysis, a user's guide for computer implementation, peer review of the code, and use of DOSTOMAN at other Department of Energy sites. 22 refs., 3 figs.

1324 **(OEVS-Mitteilung—2/85) Radioecology. Proceedings of the fall meeting 1982 of the Austrian Study Group for Radioactivity Measurements in the Danube Region.** Tschurlovits, M. (ed.). (Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna). 1985. 60p. (In German). (CONF-8211212—). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780090.

From Fall meeting of the Austrian Study Group for Radioactivity Measurements in the Danube Region; Vienna, Austria (1 Nov 1982).

Four papers on the development and evaluation of models to be used in assessing radioactive nuclide migration and the dose load of the population are presented.

1325 (OEVS-Mitteilung—2/85, pp 41-60) **Radioecological parameter studies on selected load paths.** Huber, O. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene); Paretzke, H.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780090. (CONF-8211212—).

From Fall meeting of the Austrian Study Group for Radioactivity Measurements in the Danube Region; Vienna, Austria (1 Nov 1982).

A reliability assessment is made of models used in predicting radioactive exposition of the population or parts there of in the neighbourhood of nuclear installations during routine operation. Specifically the path of terrestrial food chains is considered. It is found that with a relatively simple model the correct order of magnitude of the time-averaged values for the most important long-lived radionuclides can be predicted.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 55, 110, 112, 286, 317, 1408

1326 **(DOE/ER/60243—T1) Responses of herbivorous rodents to habitat disturbance on the North Slope of Alaska. Progress report.** Batzli, G.O. (Illinois Univ., Urbana (USA). Dept. of Ecology, Ethology and Evolution). 27 Sep 1985. Contract FG02-84ER60243. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001549.

The objectives were: (1) to determine the patterns of distribution and density of rodents along drainage systems, (2) to relate those patterns to changes in vegetation associated with disturbance, (3) to examine the mechanisms that account for observed patterns, (4) to assess changes in nutritional quality of plants after habitat dis-

turbance, and (5) to document movement of nutrients between habitats by herbivores.

52 ENVIRONMENTAL SCIENCES, AQUATIC

1327 **(INIS-mf—9767) Ground water 82: programme and extended abstracts.** (Geological Society of South Africa, Johannesburg). 1982. 237p. (CONF-8207119—Absts.). NTIS (US Sales Only), PC A11/MF A01. File Number DE86780025.

From Ground water 82; Johannesburgh, South Africa (5 Jul 1982).

Separate abstracts have been prepared for items within the scope of the Energy Data Base.

5201 Basic Studies

REFER ALSO TO CITATION(S) 88, 294, 1397

1328 **(FWS/OBS—84/24) Ecology of eelgrass meadows in the Pacific Northwest: a community profile.** Phillips, R.C. (Seattle Pacific Univ., WA (USA). School of Natural and Mathematical Sciences). Sep 1984. 98p. NTIS, PC A05/MF A01. File Number TI86900094.

This document synthesizes the extant literature pertinent to the ecology of eelgrass beds of the Pacific Northwest: that part of the coast extending from Cape Flattery, WA, to Cape Mendocino, CA. This report describes the physiographic setting of the eelgrass community, the distribution of the grass beds, autecology of the eelgrass in terms of growth and reproductive strategies and physiological requirements and functions. The ecological and functional attributes of the eelgrass system or community are also described. This approach encompasses both detailed site descriptions and a broader overview of the eelgrass community and its ecological role within the estuarine complex. The final section discusses management considerations and takes into account local issues and impact scenarios. 23 figs., 16 tabs.

1329 **(FWS/OBS—85(7.2)) Ecology of giant kelp forests in California: a community profile.** Foster, M.S.; Schiel, D.R. (San Jose State Univ., Moss Landing, CA (USA). Moss Landing Marine Labs.). May 1985. 169p. NTIS, PC A08/MF A01. File Number TI86900095.

Giant kelp forests are marine communities dominated by the large brown alga, Macrocystis pyrifera. In the northern hemisphere, stands of this species occur along the outer coast of the eastern Pacific from near Santa Cruz in central California to the central coast of Baja California, Mexico. Plants are usually attached to rocky substrata at depths of 5 to 20 m. These submarine forests are probably the most species-rich, structurally complex and productive communities in temperate waters. This profile reviews the relevant literature (over 400 citations) describing M. pyrifera, the organisms associated with it, the interactions among these organisms, and environmental factors that affect the distribution and structure of the community. The state of our knowledge about giant kelp forests is summarized, and suggestions are made for future research and management. 31 figs., 12 tabs.

1330 (INIS-mf—9767, pp 115-116) **Ground-water dating: uses, limitations, and new developments.** Davis, S.N. (Arizona Univ., Tucson). 1982. NTIS (US Sales Only), PC A11/MF A01. File Number DE86780025. (CONF-8207119—Absts.).

From Ground water 82; Johannesburgh, South Africa (5 Jul 1982).

1331 (INIS-mf—9767, pp 117-122) **Isotope hydrology of ground waters of the Kalahari, Gordonia.** Verhagen, B. Th. (Univ. of the Witwatersrand, Johannesburg, South Africa). 1982. NTIS (US Sales Only), PC A11/MF A01. File Number DE86780025. (CONF-8207119—Absts.).

From Ground water 82; Johannesburgh, South Africa (5 Jul 1982).

An intensive hydrological and geophysical survey of fresh water occurance in the Gordonia area, promoted a parallel study of the isotope hydrology and hydrochemistry of both the fresh and saline ground waters of the area. Measurements of ^{14}C, ^{3}H, ^{13}C and ^{18}O as well of major element hydrochemistry were conducted on numerous samples. Radiocarbon concentrations range from 6 pmc to 111 pmc. Significant tritium is only observed in cases where ^{14}C concentrations are significantly higher than 90 pmc.

1332 **(USGS-OFR—84-234) Fluorometric procedures for dye tracing.** Wilson, J.F. Jr.; Cobb, E.D.; Kilpatrick, F.A. (Geological Survey, Reston, VA (USA)). 1984. 64p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900017.

This manual describes the current fluorometric procedures used by the US Geological Survey in dye tracer studies such as time of travel, dispersion, reaeration, and dilution-type discharge measurements. The advantages of dye tracing are (1) the low detection and measurement limits, and (2) the simplicity and accuracy of measuring dye tracer concentrations using fluorometric techniques. The manual contains necessary background information about fluorescence, dyes, and fluorometers and a descruption of fluorometric operation and calibration procedures as a guide for laboratory and field use. The background information should be useful to anyone wishing to experiment with dyes, fluorometer components, or procedures different from those described. In addition, a brief section is included on aerial photography because of its possible use to supplement ground-level fluorometry.

1333 **(USGS/WRI—84-4139) Determination of reaeration coefficients for Ohio streams.** Hren, J. (Geological Survey, Columbus, OH (USA)). 1984. 15p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900062.

The hydrocarbon-gas tracer technique was used to determine reaeration coefficients on 30 reaches of Ohio streams. The studies were done from Septemer 1979 through August 1982 to determine the reaeration coefficients for the individual reaches and to develop general equations that could be used to estimate the coefficients. Multiple linear regression was used to determine relationships among the reaeration coefficients and physical stream characteristics. Four special equations based on the general equation were developed from various combinations of discharge, slope, width, depth, measured velocity, and estimated velocity. The standard errors of estimate for these equations ranged from 37 to 47%. The variables that resulted in the lowest standard error of estimate were discharge, slope, width, depth, and measured velocity. The most significant variables were depth and velocity. 11 refs., 1 fig., 3 tabs.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 47, 57, 58, 1038, 1299, 1321, 1344, 1359, 1454

1334 **(DOE/EV/70024—T1) Chemical and geochemical studies off the coast of Washington. Final report of progress, July 1983-July 1985.** Carpenter, R. (comp.). (Washington Univ., Seattle (USA). School of Oceanography). Jul 1985. Contract AT06-71EV70024. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000549.

This report summarizes progress from July 1983 through conclusion in July 1985 of a series of marine chemical and geochemical investigations involving both laboratory studies and field studies off the coast of Washington. Most of our field work the past few years has been on the Washington continental shelf, slope, and the submarine canyons indenting the shelf north of the Columbia River. Our aim has been to provide basic data required to characterize underlying chemical and physical processes and their rates which control the distribution, concentrations, and ultimate fate of some of the potentially hazardous agents associated with fossil fuel and/or nuclear power production or transportation. We concentrated on several processes which we feel are of special importance in the sea, and developed methodologies and expertise to study them. Laboratory and field experiments and theories derived from them were used iteratively to investigate: (1) vertical transfer of trace

chemicals from surface seawaters to underlying waters and sediments; (2) processes which may transfer certain chemicals from sediments back into the overlying water column; (3) redox processes which besides changing valence states of certain chemicals may alter their precipitation/dissolution tendencies, their biological availability and/or toxicity; and (4) accumulation histories of potentially hazardous chemicals in sediments during the past 100 years.

1335 **(FWS/OBS—80/40.20) Interactions among waterfowl, fishes, invertebrates, and macrophytes in four Maine lakes of different acidity.** Hunter, M.L. Jr.; Jones, J.J.; Gibbs, K.E.; Moring, J.R.; Brett, M. (Maine Univ., Orono (USA). Maine Cooperative Fishery Research Unit). Jul 1985. 99p. NTIS, PC A05/MF A01. File Number TI86900147.

This study addresses the influence of low pH waters on community structure and species interactions on two pairs of oligotrophic, headwater ponds that were physically similar but with markedly different acidities. The circumneutral ponds had fish and the acidic ponds were fishless. The results showed macrophyte species was lower in the acidic ponds possibly due to low pH. Density of backswimmers was greater on the acidic ponds. Tests indicated that the large numbers of backswimmers present on the acidic ponds replaced fish as a significant planktivore. Although macroinvertebrate species differed between acidic and circumneutral ponds, Diptera were the most abundant macroinvertebrates on both sets of ponds. Diptera were the principle item in the diet of brook trout in the circumneutral ponds. Because of the absence of fish in the acidic ponds, this study suggests that a potential competitor of ducks for aquatic foods had been eliminated. Ducklings on the acidic ponds grew faster, spent less time searching, and more time feeding and resting than ducklings on the circumneutral ponds. There was substantial overlap in the diet of trout and ducks, supporting the hypothesis that ducklings and fish compete for invertegrates and that, under certain circumstances, the negative effect of acidification on fish may produce a beneficial effect for ducklings. 3 figs., 30 tabs.

1336 **(ORNL/TM—9754) Investigation of landscape and lake acidification relationships.** Rush, R.M.; Honea, R.B.; Krug, E.C.; Peplies, R.W.; Dobson, J.E.; Baxter, F.P. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001450.

This interim report presents the rationale and initial results for a program designed to gather and analyze information essential to a better understanding of lake acidification in the northeastern United States. The literature pertinent to a study of landscape and lake acidification relationships is reviewed and presented as the rationale for a landscape/lake acidification study. The results of a study of Emmons Pond in northwestern Connecticut are described and lead to the conclusion that a landscape change was a contributor to the acidification of this pond. A regional study of sixteen lakes in southern New England using Landsat imagery is described, and preliminary observations from a similar study in the Adirondack Mountains are given. These results indicate that satellite imagery can be useful in identifying types of ground cover important to landscape/lake acidification relationships.

1337 **(PB—85-222792/XAB) Experimental acidification of a stream tributary to Hubbard Brook. Environmental research brief.** Hall, R.J.; Likens, G.E. (Cornell Univ., Ithaca, NY (USA)). May 1985. 9p. NTIS, PC A02/MF A01.

Long- (5 mo.) and short-term (1 h to 2 days) effects of acidic pH were measured in a poorly buffered mountain stream within the Hubbard Brook Experimental Forest, New Hampshire. Over a 5-month period aluminum, calcium, magnesium, and potassium were mobilized into the stream water during experimental acidification, and nitrogen was lost via invertebrates and organic matter. Periphyton biomass increased at low pH and fungal densities increased. Emergence of adult mayflies, stoneflies and true flies decreased, whereas immature invertebrates in the drift increased. Short-term pulses of acid also changed the stream ecosystem as indicated by significant net fluxes of organic carbon, nitrogen, and phosphorus in biologically bound forms. Aluminum chloride was added to the stream to simulate increased aluminum concentrations during snowmelt. A significant decrease in pH and dissolved organic carbon (DOC) occurred, as well as an increase in foam accumulation at the stream surface. Foam production is thought to be due to decreased surface tension of the water. A 20% reduction of surface tension of stream water was measured in the laboratory. The cause of the reduction is postulated to be the formation of organo-aluminum complexes in the stream. Increases in aluminum concentration were accompanied by changes in both terrestrial and aquatic drift behavior. Six citations are given for complete publications.

1338 **(PB—85-222834/XAB) Water-borne routes of human exposure through food and drinking water (revised). Final report.** Perwak, J.; Adamson, F.; Gilbert, D.; Scow, K.; Wallace, D. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Apr 1983. 62p. NTIS, PC A04/MF A01.

The report discusses methods for identifying and quantifying water-borne routes of contamination of human food and drinking water. The work was performed for the U.S. Environmental Protection Agency (EPA) as part of a program to assess exposure/risk of 65 classes of chemicals (129 priority pollutants) in the water environment. It is intended as a first step in developing methods for estimating levels of contaminants in food and drinking water resulting from water-borne routes of migration. Points of water contact with food in growth stages, processing, and preparation are identified. A simplified methodology is presented for evaluating pollutant intakes during the growth phase of crops, livestock, poultry, and fish, and information is presented on water use in food processing and home preparation. The routes of contamination of drinking water during treatment and distribution are identified.

1339 **(PB—85-226322/XAB) Organic contaminant transport in ground water, surface water, and surface water sediments: Year 1 progress report.** Crossey, M.J.; Bergman, H.L. (Wyoming Univ., Laramie (USA). Coll. of Arts and Sciences). 7 Sep 1984. 35p. NTIS, PC A03/MF A01.

Questions concerning the transport and fate of contaminants in the environment have typically been limited to single compounds. Hazardous-waste disposal facilities, chemical plants, oil refineries, etc., however, typically produce complex waste streams which may contact groundwater or surface waters. The study gives results on movement through ground and surface water of a complex mixture of organic compounds emanating from a wood-treatment facility located adjacent to the Laramie River in Laramie, Wyoming.

1340 **(SANSP—90) Pipeline discharges of effluents to sea. Proceedings of a workshop held at Hermanus, South Africa, 24-26 May 1983.** Lord, D.A.; Anderson, F.P.; Basson, J.K. (eds.). (South African National Committee for Oceanographic Research, Pretoria). Oct 1984. 116p. (CONF-8305284—). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780103.

From Pipeline discharges of effluents to sea; Hermanus, South Africa (24 May 1983).

Individual papers were processed for inclusion in the Energy Data Base.

1341 **Toxicity of polyaromatic hydrocarbons and alkyl halides in Great Lakes fish to Daphnia pulex.** Smith, S.B.; Savino, J.F.; Passino, D.R.M. (Great Lakes Fishery Lab., Ann Arbor, MI). pp 63 of Program and abstracts of the 28th conference on Great Lakes research. Milwaukee, WI; Univ. of Wisconsin (1985). (CONF-850660—).

From 28. conference on Great Lakes research; Milwaukee, WI, USA (3 Jun 1985).

Based on preliminary toxicity data, widespread occurrence, and relatively high concentrations in Great Lakes fish, polyaromatic hydrocarbons (PAHs) and alkyl halides were listed by the Great Lakes Fishery Laboratory as potentially hazardous to aquatic biota. Acute toxicity tests using Daphnia pulex at 20°C in reconstituted water have been conducted for these two chemical classes either identified as present in Great Lakes fish or representative of these classes. Toxicity values (48-h EC50's) for PAHs ranged from 0.078 mg/l for 2,6-dimethylnapthalene to 4.66 mg/l for naphthalene. Other PAHs tested were derivatives of anthracene and naphtha-

lene, fluorene, phenanthrene and hydrindan. Toxicity values for alkyl halides ranged from 0.074 mg/l for 1-bromodecane to 8.5 mg/l for bromocyclohexane. Other alkyl halides tested were short, long and cyclic alkanes containing chlorine, bromine and PAHs and alkyl halides having the greatest impact on the fishery resources.

1342 **Program and abstracts of the 28th conference on Great Lakes research.** Milwaukee, WI; University of Wisconsin (1985). 69p. (CONF-850660—).

From 28. conference on Great Lakes research; Milwaukee, WI, USA (3 Jun 1985).

Abstracts of papers presented at the 28th Conference on Great Lakes Research and the annual meeting of the International Association for Great Lakes Research covered two symposia. The first was a comparison of Great Lakes and Baltic ecosystems, which provided an opportunity for international exchanges of information and insights. The second featured pollution problems in the Green Bay estuary environment that is of particular value to Wisconsin and Michigan. There are 41 separate abstracts selected for the Energy Data Base (EDB). Four of those were also selected for Energy Research Abstracts (ERA), six for Energy Abstracts for Policy Analysis (EAPA), and two for INS.

1343 **Effects of stochastic P inputs and ice cover on optimal Great Lakes P Management strategies.** Fontaine, T.D.; Lesht, B.M. (NOAA-GLERL, Ann Arbor, MI). pp 39 of Program and abstracts of the 28th conference on Great Lakes research. Milwaukee, WI; University of Wisconsin (1985). (CONF-850660—).

From 28. conference on Great Lakes research; Milwaukee, WI, USA (3 Jun 1985).

A long-term goal of the United States and Canada is to return phosphorus concentrations of the Great Lakes to desirable levels. Towards attaining this goal, linear programming techniques can be used to determine optimal, cost effective methods of controlling point and diffuse inputs of phosphorus. Because optimal solutions can be influenced by changing technology, economics, and in the case of the Great Lakes the stochastic nature of their phosphorus inputs and ice cover, it was of interest to determine if (1) an algorithm could be developed for defining optimal phosphorus management strategies under time variable conditions and (2) whether the optimal solutions generated in (1) would be the same as those determined by existing models which calculate optimal solutions based on average loading and ice conditions. The results of the two methods differ and indicate that the stochastic nature of phosphorus loading and ice cover should be taken into account when formulating optimal phosphorus management policies for the Great Lakes.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 192, 207, 210, 211, 212, 213, 217, 222, 225, 1038, 1316, 1340

1344 **(DPSPU—84-11-11) Closure plan for the M-Area settling basin and vicinity at the Savannah River Plant.** Colven, W.P.; Pickett, J.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jul 1985. Contract AC09-76SR00001. 299p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE86001868.

The areas addressed in this closure plan include a process sewer line, surface impoundment (settling basin), overflow ditch, seepage area, and a Carolina Bay known as Lost Lake. Since it is proposed that the basin and vicinity be closed with the hazardous wastes placed and stabilized in the basin, it will be closed pursuant to regulations for closing a hazardous waste landfill. No free liquids will remain in the impoundment after closure is completed.

1345 (INIS-mf—9758, pp vp) **Radioecological investigation of the Baltic Sea.** Duniec, S.; Hallstadius, L.; Holm, E. 1984. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85781601. (CONF-8410282—Absts.).

From 7. Nordic Society for Radiation Protection ordinary meeting; Copenhagen, Denmark (10 Oct 1984).

1346 (INIS-mf—9758, pp vp) **Seasonal variations of fission and activation products in algae along the Swedish eastern coastline.** Duniec, S.; Carlson, L.; Hallstadius, L.; Holm, E. 1984. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85781601. (CONF-8410282—Absts.).

From 7. Nordic Society for Radiation Protection ordinary meeting; Copenhagen, Denmark (10 Oct 1984).

1347 (INIS-mf—9758, pp vp) **Beryllium 7 in Fucus vesiculosus (L.).** Erlandsson, B.; Carlsson, L.; Mattsson, S. (Lund Univ., Sweden). 1984. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85781601. (CONF-8410282—Absts.).

From 7. Nordic Society for Radiation Protection ordinary meeting; Copenhagen, Denmark (10 Oct 1984).

1348 (INIS-mf—9767, pp 237) **Environmental isotope observations on Sishen ground waters.** Verhagen, B. Th. (Univ. of the Witwatersrand, Johannesburg, South Africa). 1982. NTIS (US Sales Only), PC A11/MF A01. File Number DE86780025. (CONF-8207119—Absts.).

From Ground water 82; Johannesburgh, South Africa (5 Jul 1982).

Environmental isotope measurements have been conducted on the outputs of some of the main dewatering points in both north and south mining areas as well as on numerous other observation points in the Sishen compartment. The effect of the dykes bounding the compartment could be observed from the behaviour of the isotopic composition of ground waters in the conduit zone. Measurements were done on radiocarbon, tritium oxygen-18 and carbon-13.

1349 (INIS-mf—9767, pp 123-126) **Geohydrological investigation of an uranium anomaly near Vanzylsrus in the Northern Cape Province.** Levin, M.; Talma, A.S.; Vogel, J.C. (Council for Scientific and Industrial Research, Pretoria, South Africa). 1982. NTIS (US Sales Only), PC A11/MF A01. File Number DE86780025. (CONF-8207119—Absts.).

From Ground water 82; Johannesburgh, South Africa (5 Jul 1982).

An anomaly, caused by low-grade uranium accumulations in organic-rich diatomaceous earth deposits, was located by an airborne radiometric survey near Vanzylsrus in the Northern Cape. Low-grade uraniferous calcrete also occurs in the vicinity of the anomaly. A significant uranium anomaly was found along the whole course of the palaeodrainage with the highest values occuring behind a dolerite dyke a few kilometres south of the confluence. A multidisciplinary approach in corporating geohydrology, water geochemistry, isotopic data and radiometric borehole logging studies was used to evaluate its potential.

1350 (OEVS-Mitteilung—2/85, pp 29-39) **Calculations for dispersion of radioactive materials in rivers. Austrian part of the Danube.** Prohaska, G.; Tschurlovits, M. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780090. (CONF-8211212—).

From Fall meeting of the Austrian Study Group for Radioactivity Measurements in the Danube Region; Vienna, Austria (1 Nov 1982).

Models for the dispersion of radioactive materials in running waters are discussed and applied in the Austrian Danube region. The used models take into account dilution, decay and retention in river sediments under the assumption that the activity is released homogeneously at the water entrance into Austria. Some results are presented as examples.

1351 **(ORNL—6110) Radionuclide daughter inventory generator code: DIG.** Fields, D.E.; Sharp, R.D. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001486.

The Daughter Inventory Generator (DIG) code accepts a tabulation of radionuclide initially present in a waste stream, specified as amounts present either by mass or by activity, and produces

a tabulation of radionuclides present after a user-specified elapsed time. This resultant radionuclide inventory characterizes wastes that have undergone daughter ingrowth during subsequent processes, such as leaching and transport, and includes daughter radionuclides that should be considered in these subsequent processes or for inclusion in a pollutant source term. Output of the DIG code also summarizes radionuclide decay constants. The DIG code was developed specifically to assist the user of the PRESTO-II methodology and code in preparing data sets and accounting for possible daughter ingrowth in wastes buried in shallow-land disposal areas. The DIG code is also useful in preparing data sets for the PRESTO-EPA code. Daughter ingrowth in buried radionuclides and in radionuclides that have been leached from the wastes and are undergoing hydrologic transport are considered, and the quantities of daughter radionuclide are calculated. Radionuclide decay constants generated by DIG and included in the DIG output are required in the PRESTO-II code input data set. The DIG accesses some subroutines written for use with the CRRIS system and accesses files containing radionuclide data compiled by D.C. Kocher. 11 refs.

1352 **(TVA/PUB—86/3) Environmental radioactivity levels in the Cumberland River at the Hartsville Nuclear Project site, 1975-1982.** (Tennessee Valley Authority, Muscle Shoals, AL (USA). Radiological Health Staff). Jul 1985. 64p. NTIS, PC A04/MF A01. File Number DE86900103.

Samples of surface water taken from the Cumberland River during the period from 1975 through 1982 exhibited radioactivity levels less than 1% of the maximum permissible concentrations published by the Nuclear Regulatory Commission. Radioactivity concentrations reported herein are typical of natural radioactivity levels with slight indications of influences from fallout of radioactivity from atmospheric nuclear weapons testing.

5205 Site Resource And Use Studies

1353 **(DOE/BP/11902—2) Enloe Dam Passage Project. Volume II. Appendices. Annual report 1984.** Fanning, M.L. (IEC Beak Consultants Ltd., Richmond, British Columbia (Canada)). Jun 1985. Contract AC79-83BP11902. 269p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86002024.

This report contains the following appendices: (1) correspondence and minutes of meetings; (2) Similkameen River system summer creel survey; (3) disease analysis; (4) water quality tables; (5) Boundary Waters Treaty; and (6) other NEPA information. (ACR)

1354 **(DOE/BP/12737—1) Stock assessment of Columbia River anadromous salmonids. Volume I. Chinook, coho, chum and sockeye salmon stock summaries. Final report, 1984.** Howell, P.; Jones, K.; Scarnecchia, D.; LaVoy, L.; Kendra, W.; Ortmann, D. (Oregon Dept. of Fish and Wildlife, Corvallis (USA); Washington State Dept. of Fisheries, Olympia (USA); Washington State Dept. of Game, Olympia (USA); Idaho Dept. of Fish and Game, Boise (USA)). Sep 1985. Contract AI79-84BP12737. 580p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE86002023.

The purpose was to identify and characterize the wild and hatchery stocks of salmon and steelhead in the Columbia River Basin on the basis of currently available information. This report provides a comprehensive compilation of data on the status and life histories of Columbia Basin salmonid stocks.

1355 **(DOE/BP/12737—2) Stock assessment of Columbia River anadromous salmonids. Volume II. Steelhead stock summaries, stock transfer guidelines - information needs. Final report.** Howell, P.; Jones, K.; Scarnecchia, D.; LaVoy, L.; Kendra, W.; Ortmann, D. (Oregon Dept. of Fish and Wildlife, Corvallis (USA); Washington State Dept. of Fisheries, Olympia (USA); Washington State Dept. of Game, Olympia (USA); Idaho Dept. of Fish and Game, Boise (USA)). Sep 1985. Contract AI79-84BP12737. 484p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE86001934.

This report presents brief descriptions of wild and hatchery-raised steelhead trout stocks in the Columbia River Basin. (ACR)

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

1356 **(NUREG/CR—0743) Transportation of radionuclides in urban environs: draft environmental assessment.** Finley, N.C.; Aldrich, D.C.; Daniel, S.L.; Ericson, D.M.; Henning-Sachs, C.; Kaestner, P.C.; Ortiz, N.R.; Sheldon, D.D.; Taylor, J.M. (Arizona Univ., Tucson (USA). Field Emission and Space Systems Lab.; Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 571p. (SAND—79-0369). NTIS, PC A24/MF A01 - GPO. File Number TI86000909.

This report assesses the environmental consequences of the transportation of radioactive materials in densely populated urban areas, including estimates of the radiological, nonradiological, and social impacts arising from this process. The chapters of the report and the appendices which follow detail the methodology and results for each of four causative event categories: incident free transport, vehicular accidents, human errors or deviations from accepted quality assurance practices, and sabotage or malevolent acts. The numerical results are expressed in terms of the expected radiological and economic impacts from each. Following these discussions, alternatives to the current transport practice are considered. Then, the detailed analysis is extended from a limited area of New York city to other urban areas. The appendices contain the data bases and specific models used to evaluate these impacts, as well as discussions of chemical toxicity and the social impacts of radioactive material transport in urban areas. The latter are evaluated for each causative event category in terms of psychological, sociological, political, legal, and organizational impacts. The report is followed by an extensive bibliography covering the many fields of study which were required in performing the analysis.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 459, 460

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 220, 221, 461, 464, 578

1357 **(FES—81-25) Coalstrip Project final environmental impact statement, FES 79-29. Final supplement.** (Bureau of Land Management, Billings, MT (USA); Forest Service, Billings, MT (USA); USDOE Bonneville Power Administration, Portland, OR). Jul 1981. 397p. NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE86001836.

This supplement to the Final Colstrip Project EIS evaluates additional 500-kV transmission line corridor alternatives between Boulder and Garrison, Montana, including the Designated Corridor identified in the Colstrip Project Federal Transmission Corridor Record of Decision dated September 21, 1979. This supplement is the result of new information and public involvement obtained during the process of locating the centerline within the corridor designated for the crossing of Federal lands. During that process locations outside the Designated Corridor were identified. Two additional alternatives were studied in the Boulder area and eleven additional alternatives were evaluated in the Deer Lodge area. Also evaluated were four substation sites for integrating electric energy from Colstrip Unit 3 with the Federal Columbia River Transmission System by September 1983.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

1358 **(INIS-BR—294) Proceedings of the 4. Japan-Brazil Symposium on Science and Technology. Vol. 2.** (Academia de Ciencias do Estado de Sao Paulo (Brazil)). 1984. 289p. (CONF-8408159—Vol.2). NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033.

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

Brazilian papers about biotechnology and bioengineering are presented. (E.G.).

1359 **(ORNL/M—88) Biomedical and environmental sciences at Oak Ridge National Laboratory.** (Oak Ridge National Lab., TN (USA)). [1985]. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001639.

The booklet describes the themes, activities, and facilities of the Biomedical and Environmental Sciences Program at Oak Ridge National Laboratory. Programs described include those in the Biology Division, Environmental Sciences Division, Health and Safety Research, and the Biotechnology Program. (ACR)

5502 Biochemistry

REFER ALSO TO CITATION(S) 302, 1095, 1124, 1367, 1439, 1455

1360 (CONF-840408—, pp 813-824) **Some aspects of choice of specimen for biomedical trace element research studies in human subjects.** Iyengar, G.V.; Kollmer, W.E. (Juelich Nuclear Research Center, West Germany). Apr 1984. NTIS, PC A99/MF A01. File Number DE84017348.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

An attempt is made to extend the examination of the biological background of human specimens in order to identify their suitability to reflect the desired elemental composition status meaningfully, and to view the analytical aspects to ensure reliability. A few examples, which have shown consistent results of practical value are presented. They include: blood, hair, urine, feces, and milk. The most meaningful analysis can be done in the organs which are damaged if an essential element is not present in a sufficient amount or a harmful element is present at a toxic level. e.g., liver and kidney. 20 references, 2 tables.

1361 **(DOE/CE/40658—T1) Development of microbial dehalogenating enzymes for the detoxification of industrial wastes. Final report, September 1, 1984-August 31, 1985.** Suflita, J.M. (Oklahoma Univ., Norman (USA). Dept. of Botany and Microbiology). Aug 1985. Contract AC02-84CE40658. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001860.

This project was designed to explore the possibility of using newly discovered anaerobic aryl dehalogenation reactions to pretreat industrial effluents prior to conventional treatment. Initial phases of the work focused on attempts to isolate and characterize the requisite dehalogenaes. Based on results generated in this project and other projects, we initially hypothesized that aryl dehalogenases were related to other anaerobic bioconversions such as aryl demethoxylation reactions. Both reactions were catalyzed by a dehalogenating consortium without a lag and exhibited Michaelis-Menten kinetics. The kinetic parameters associated with the microbial dehalogenation of 3-chlorobenzoate and 3-methoxybenzoate were measured and incorporated into a mathematical model consisting of two non-linear differential equations. The model included a competitive inhibition term designed to assess the influence of one substrate on the metabolism of the other. However, a comparison of computer simulated results with the experimental evaluation, proved the original hypothesis to be incorrect. Further hypotheses were based on the assumption that halogenated aromatic materials may be acting as artificial electron acceptors. Only toward the end of the project were we able to successfully demonstrate dehalogenation activity with cell-free extracts obtained from a dehalogenating bacterial consortium. Therefore, the prospects for isolating anaerobic aryl dehalogenases have significantly improved through this project.

1362 (INIS-BR—294, pp vp) **Preparation of ^{35}S-methionine.** Rondinelli, E.; Moussatche, N.; Oliveira Carvalho, J.F. de; Carvalho, M.G.C.; Moura Neto, R.S.; Lobo, D.S.; Frugulhetti, I.C.; Silva, R.; Rebello, M.A. (Rio de Janeiro Univ., Brazil). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

1363 (INIS-mf—9472, pp 60) **Radioreceptor assay.** Kimlova, I. (Karlova Univ., Prague (Czechoslovakia). Lekarska Fakulta Hygienicka); Hampl, R. (Vyzkumny Ustav Endokrinologicky, Prague (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1364 **(LA-UR—85-2985) New roles for computation in the life sciences.** Bell, G.I. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850784—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85017542.

From Computer analysis for life science; Okayama, Japan (9 Jul 1985).

Important new roles for computation in the life sciences are being found in the study of the linear polymers DNA, RNA, and proteins, and in the correlation of the sequence with the structure and function of each. Because of the ease with which DNA sequences can be determined and the definitive and often surprising information contained in the sequences, an explosion of biological information is taking place that will increasingly rely on computers for its analysis and understanding. 4 refs., 2 figs. 1 tab.

1365 **(LA-UR—85-3268) Neutron diffraction studies of bacteriorhodopsin.** Trewhella, J.; Popot, J.L.; Engelman, D.M.; Zaccai, G. (Los Alamos National Lab., NM (USA); Yale Univ., New Haven, CT (USA); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850871—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000763.

From International conference on neutron scattering; Santa Fe, NM, USA (19 Aug 1985).

Neutron diffraction studies of bacteriorhodopsin have utilized the entire range of deuterium labeling techniques that are commonly used in biological neutron scattering experiments. We will review the work published in this area and report on current projects. 10 refs., 1 fig.

5504 Genetics

REFER ALSO TO CITATION(S) 1364

5505 Metabolism

REFER ALSO TO CITATION(S) 1444

1366 **(AECL—8401) EWAM: a model for predicting food and water ingestion, and inhalation rates of man.** Zach, R.; Barnard, J.W. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1985. 59p. AECL, Chalk River, Ontario, Canada $4.00. File Number TI86900117.

Work performed under Canada/US Waste Management Information Exchange Agreement.

A computer model, EWAM (Energy, Water and Air Model), has been designed and implemented for predicting food and water ingestion, and inhalation rates of man for use in environ-

mental assessment models. EWAM uses physiological, energetic, nutritional and physical relationships in combination with activity time budgets, and mass and energy balances. The calculated ingestion and inhalation rates are closely related. Various age and sex classes of man are taken into account. EWAM is best described as a deterministic equilibrium or steady-state model, operating on a daily time-scale with both detailed research and more general assessment model features. The parameters of EWAM are reviewed and suitable values recommended to allow biologically meaningful predictions. 78 refs., 8 figs., 2 tabs.

1367 **(DOE/ER/13107—3) Role of Ca^{2+}/calmodulin in phosphorylation of proteins in plants. Final report, 1 August 1983-31 July 1985.** Cormier, M.J. (Georgia Univ., Athens (USA)). 1985. Contract AS09-83ER13107. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001804.

In order to elucidate the role of Ca^{2+}-dependent protein phosphorylation in plant cell function, a Ca^{2+}-dependent protein kinase from suspension-cultured soybean cells has been partially purified and characterized. It was previously shown that crude extracts of the soybean cells contain soluble protein kinase(s) that preferentially phosphorylates at least eight endogenous proteins in vitro in the presence of 0.5 mM $CaCl_2$. An assay based on phosphorylation of the artificial substrate histone H1 has been devised. 26 refs., 4 figs.

1368 (INIS-BR—294, pp vp) **Regulation of trehalose metabolism in Saccharomyces. An approach to the improvement of technological processes.** Panek, A.D.; Costa-Carvalho, V.L.A.; Ortiz, C.H.D.; Dellamora-Ortiz, G.M.; Paschoalin, V.M.F.; Panek, A.C. (Rio de Janeiro Univ., Brazil). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

The regulation of trehalose metabolism in Saccharomyces is studied by construction of mutants with specific lesions, cloning of genes involved in the regulation of trehalose synthase and of trehalase, as well as, isolation and purification of enzymes from the various mutants constructed. (M.A.C.).

5506 Medicine

REFER ALSO TO CITATION(S) 257, 257, 1113, 1138, 1139, 1142, 1143, 1144, 1145, 1146, 1415, 1417, 1429, 1446

1369 **(CEA-CONF—7828) Parkinson disease and positron tomography.** Baron, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1984. 6p. (In French). (CONF-8410332—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752880.

From Meeting on Parkinsons disease; Bari, Italy (28 Oct 1984).

Physiopathologic investigations of Parkinson disease and parkinsonian syndrome using positron tomography are briefly reviewed: study of cerebral blood flow and metabolism; effects of L-DOPA; study of dopaminergic receptors and of ^{18}F-Fluoro-L-DOPA incorporation.

1370 **(DOE/EV/03333—T4) New imaging systems in nuclear medicine. Technical progress report, January 1, 1985-November 1, 1985.** Brownell, G.L. (Massachusetts General Hospital, Boston (USA)). 1985. Contract AC02-76EV03333. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001626.

Developments of improved imaging systems in nuclear medicine are reported with emphasis on development of positron emission tomographs that combine high resolution, with high sensitivity and high count rate capability. A second generation cylindrical analog positron camera design has provided excellent light collection with limited light spread, characteristics needed for high spatial and temporal resolution. Other aspects of the camera development include the design of associated electronics, and provision for data storage and processing. Utilizing the above camera basic studies have been performed to evaluate blood flow in the cat brain stem during auditory stimulation, ventilation in the dog using ^{13}N and blood flow in the canine heart. 2 refs., 2 figs.

1371 **(FRCEA-TH—4) Emission tomography: quantitative aspects in metabolic and physiopathologic studies.** Yerouchalmi-Soussaline, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-11 Univ., 91 - Orsay (France)). Nov 1984. 357p. (In French). NTIS (US Sales Only), PC A16/MF A01. File Number DE85752881.

This thesis presents instrumental and data processing studies developed in emission tomography in man, using gamma and positron emitting tracers. High contrast visualisation of volume distribution of tracers in the organs, kinetic studies and measurements of radioactive concentration or of other clinical parameters necessitate a detailed analysis of all physical factors limiting the accuracy of the measure; therefore, development of adapted imaging devices and data processing techniques, together with models describing correctly the phenomena under study are to be carried out. Thus, in single photon (gamma) emission tomography an image reconstruction strategy is elaborated, based on an analytical model for the ill-posed problem including the attenuation effect. In positron emission tomography, the time-of-flight information combined with the reconstruction technique is used in the design of a first prototype imaging device which performance is presented and evaluated in a clinical environment. Moreover, a priori or a posteriori techniques correcting for Compton diffusion events, limited statistics and limited resolutions, are proposed and discussed for the improvement of regional measurement accuracy, in metabolic and physiopathologic studies.

1372 **(FRNC-TH—1545) Development of a general solid-phase radioimmunoassay method. Application to follicle stimulating hormone and to luteinizing hormone radioimmunoassays.** Fleury, B. (Lyon-1 Univ., 69 - Villeurbanne (France)). Oct 1981. 125p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752877.

A solid phase method of radioimmunoassay utilizing a second antibody adsorbed onto tubes was developed. Polyethylene tubes were selected for their adsorption capacity. The following topics were emphasized: the rate of labelled antigen uptake on the second antibody adsorbed on the tubes through the medium of the first antibody; the influence of the second antibody on the antigen-first antibody reaction and comparison with the immunoprecipiting technique; the various factors able to influence the calibration curve and applications to assay optimization; the performances of hFSH AND hLH assays.

1373 (INIS-BR—294, pp vp) **Development of emission computed tomography in Japan.** Tanaka, E. 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

Two positron emission computed tomography (PCT) devices developed in Japan are described. One is for head and the other for wholebody. The devices show fairly quantitative images with slight modifications of the existing algorithms because they were developed based on filtered back-projection. The PCT device seems to be better than the single photon emission computed tomography (SPECT) since it provides adequade compensation for photon attenuation in patients. (M.A.C.).

1374 (INIS-BR—294, pp vp) **Molecular biological applications to viral diagnosis.** Pereira, H.G. (Instituto Oswaldo Cruz, Rio de Janeiro, Brazil). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

1375 (INIS-BR—294, pp vp) **Obtention of sheep anti-rabbit IgG: precipitating system of radioimmunoassay.** Ogata, H.; Higuchi, T. (Sao Paulo Univ., Brazil). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

1376 (INIS-BR—294, pp vp) **Perspectives on avian and bovine leukemia virus immunological studies.** Higuchi, T.; Souza, J.M.M. de; Nogueira, Z.M.; Ogata, H. (Sao Paulo Univ., Brazil). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

The avian and bovine RNA virus are studied. The mechanism of replication, the genome, the ultrastructural composition, the immunogens reactivity, the class of determinants and affinity are presented. Purification techniques of viral proteins and immunoassay proceeding are reported. (M.A.C.).

1377 (INIS-BR—304, pp 53-54) **Advantages of the use of /sup 99m/Tc (Rhenium) for bone marrow scintigraphy.** Gaudiano, J.; Berriolo, A.; De Pena, P.; Martinez, G.; Gonzalez, L.D.; Suero, C.; Touya, E. (Centro de Medicina Nuclear e Inst. de Ortopedia y Traumatologia MSP-Hospital de Clinicas, Montevideo (Uruguay)). 1984. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. File Number DE86780055. (CONF-8404259—Absts.).

From 4. congress of the Brazilian Society of Biology and Nuclear Medicine; Porto Alegre, Brazil (28 Apr 1984).

Published in summary form only.

1378 (INIS-BR—304, pp 59) **Importance of radioimmunoassay in FSH and LH dosages in hypergonadotrophic secondary amenorrhoeas.** Blum, B.; Linhares, E. (Instituto Brasileiro de Medicina Nuclear, Rio de Janeiro (Brazil)). 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86780055. (CONF-8404259—Absts.).

From 4. congress of the Brazilian Society of Biology and Nuclear Medicine; Porto Alegre, Brazil (28 Apr 1984).

Published in summary form only.

1379 (INIS-mf—9365) **Value of skeletal scintiscanning in cases of primary bone tumours and tumourous alterations.** Sokolowski, U. (Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). 26 Feb 1982. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE86780036.

In the course of an investigation on the storage behaviour of primary bone tumours and tumourous bone alterations the skeletal scintigrams of a total of 26 patients were evaluated. Bone scintiscanning was done according to current practice after injection of an average amount of 10mCi sup(99m)Tc-MDP, followed by a semiquantitative evaluation. In all cases of malignant bone tumours there was fond to be increased storage of radionuclide; with benign bone alterations this was so in 70 per cent of cases. To differentiate between benign and malignant tumours respectively inflammatory bone diseases was not as a rule possible; however, the investigation yielded additional information completing the X-ray findings essentially. Thus very high storage of radioactivity was established for all osteosarcomas, whereas benign bone growths exhibited more circumscribed accumulations of activity. Skeletal scintiscanning for diagnostical purposes is particularly informative as to the early detection of bone foci evading X-ray diagnosis, more accurate delimitation of tumourous processes, and course control of tumours tending to degenerate. (orig./MG).

1380 (INIS-mf—9367) **Excretory urogramm with angiotomography: imaging of the renal arteries by excretory urogramm. Experimental investigations and results.** Binder, G. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 3 Aug 1982. 112p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780034.

Excretory urography permits imaging of the renal arteries up to the intrarenal ramification if the contrast medium is injected as a bolus and the time of circulation between arm vein and abdominal aorta is determined with sufficient accuracy. Imaging of the vessel phase is done using simultaneous tomography. In the experimental part of the paper phantom tests are carried through to establish the contrast medium concentration to be expected in the renal arteries by means of microdensitometry. With the aid of 100 computerized tomograms of the abdomen the layer thickness required was determined to 4.5 cm; further phantom tests provided the necessary layer distances to image renal arteries that do not run in parallel to the plain of the film. The circulation time between arm vein and abdominal aorta was measured in 180 patients using the radioisotope method. It ranges between 9 and 22 seconds. Comparisons with the Decholin-method were made. 739 renal arteries were seen during the evaluation of 343 excretory urographies with angiotomograms, in 83 per cent of the cases these arteries were presented entirely. Provided perfect execution, simultaneous tomography is a very informative method. For 212 patients the side-effects of the bolar contrast medium injection were recorded. The importance of excretory urography with combined angiotomography for the diagnosis of arterial hypertension is discussed. (orig.).

1381 (INIS-mf—9472, pp 71) **Contribution of storage facility for used radioactive injection needles to improved hygiene and safety of work at nuclear medicine department.** Kopacek, R. (Krajsky Ustav Narodniho Zdravi, Usti nad Labem (Czechoslovakia). Oddeleni Nuklearni Mediciny). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1382 (INIS-mf—9472, pp 91) **Application of Victoreen 2810 instrument in protective dosimetry using TLD in nuclear medicine.** Kubistova, J.; Ott, O. (Vyzkumny Ustav Klinicke a Experimentalni Onkologie, Brno (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1383 (INIS-mf—9472, pp 57) **Effect of some factors on detection of local ischemia of myocardium using radionuclides.** Kasalicky, J.; Stys, V. 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1384 (INIS-mf—9472, pp 58) **Significance of determining carcinoembryal antigen in mammary gland carcinoma.** Kausitz, J.; Hupka, S.; Tesarek, T.; Godal, A.; Pelikan, A. (Subkatedra Nuklearnej Mediciny, Bratislava (Czechoslovakia)). 1981. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1385 (INIS-mf—9472, pp 61) **Effect of different techniques of data display in scintillation camera examinations.** Kleinbauer, K.; Erban, J. (Fakultni Nemocnice, Olomouc (Czechoslovakia). Oddeleni Nuklearni Mediciny). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1386 (INIS-mf—9472, pp 64) **Monitoring of Hodgkin's lymphomas at nuclear medicine department.** Kocmerzevska, H.; Plockova, M.; Zelenkova, J.; Vohnoutova, M.; Sedmihorska, J. (Karlova Univ., Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1387 (INIS-mf—9472, pp 79) **Effect of collimation on radiocirculographic curve. Comparison of own and commercial collimators.** Kovacikova, M.; Srbecka, A.; Paldanova, V. (Radioizotopove Pracovisko I. Internej Kliniky Fakultni Nemocnice, Bratislava (Czechoslovakia)). 1981. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1388 (INIS-mf—9472, pp 86) **Radioimmunoassay (RIA) in detection of hepatitis B (HB).** Kselikova, M.; Novak, J.; Urbankova, J. (Ustav Hematologie a Krevni Transfuze, Prague (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1389 (INIS-mf—9472, pp 88) **Diagnosis and therapy of autonomous thyroid adenomas.** Kuba, J.; Kuchar, O.; Mueller, J. 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1390 (INIS-mf—9472, pp 94) **/sup 99m/Tc-DMS, an indicator for scintigraphic imaging of kidneys - some experimental and clinical aspects.** Kupka, K.; Hanza, J. (Karlova Univerzita, Jilemnice (Czechoslovakia). Ustav Biofyziky a Nuklearni Mediciny Fakulty Vseobecneho Lekarstvi); Grossmann, V. Jr.; Stach, E.; Odvarko, J. (Oddeleni Nuklearni Mediciny Nemocnice, Jilemnice (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1391 (INIS-mf—9472, pp 95) **Current state and applications of prolactine and testosterone determinations.** Kuprova, M.; Ruzicka, E. (Okresni Ustav Narodniho Zdravi, Kolin (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1392 (INIS-mf—9472, pp 98) **"Secondary findings" in kidneys and urinary tract in scintigraphy of skeleton using / sup 99m/Tc-diphosphate and /sup 99m/Tc-pyrophosphate.** Lipsova, H.; Pradacova, J.; Dienstbier, Z. (Karlova Univ., Prague (Czechoslovakia). Biofyzikalni Ustav); Schnorr, D.; Schuerer, M.; Correns, H.-J. (Staedtisches Klinikum Berlin-Buch (German Democratic Republic)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1393 (INIS-mf—9472, pp 101) **Importance of skeletal gammagraphy in differential diagnosis of focal processes in the spine.** Makaiova, I.; Hupka, S.; Makai, F.; Vivodova, M. (Komenskeho Univ., Bratislava (Czechoslovakia). Lekarska Fakulta); Kausitz, J.; Rajniakova, L. (Ustav Klinickej Onkologie, Bratislava (Czechoslovakia)); Pipa, V.; Kutarna, A.; Huraj, E. Sr. (Institut pre Doskolovanie Lekarov a Farmaceutov, Bratislava (Czechoslovakia)). 1981. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1394 (INIS-mf—9472, pp 103) **Application of radioisotope methods in diagnosis of hypothalamo-hypophyseal disorders.** Marek, J.; Sramkova, J. (Karlova Univ., Prague (Czechoslovakia). 3. Interni Klinika). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

Published in summary form only.

1305 (INIS-mf—9910-Vol.2, pp 1-24) **Biomedical tumor research with 133 Cs and 132 Cs.** Pinsky, C.; McKee, J.S.; Bertalanffy, F.D. (Manitoba Univ., Winnipeg (Canada). Cyclotron Lab.). 1983. NTIS (US Sales Only), PC A23/MF A01. File Number DE86780089. (CONF-830660—Vol.2).

From 23. annual international conference of Canadian Nuclear Association and 4. annual conference of the Canadian Nuclear Society; Montreal, Canada (12 Jun 1983).

We have been studying the effect of stable sup(133)Cssup(+) ion on malignant cells in mice, following reports that stable cesium ion has antitumor effects in laboratory animals and that the ion may have a selective affinity for malignant tumor cells in cancer patients. We have found that treatment with sup(133)Cs, given intraperitoneally, significantly reduces the size and substantially lessens the number of skin tumors that develop in Swiss-Webster mice submitted to a carcinogenic combination of benzo(a)pyrene with oleic acid. The treatment also significantly increased mean latency to eruption of tumor. This antitumor effect of sup(133)Cs against chemical induction of tumors has not been previously described. We found also that sup(133)Cs treatment has a significant antitumor effect on mammary tumor cells implanted into syngeneic BALB/c mice, thereby confirming and extending earlier reports from elsewhere of antimalignancy properties for cesium. The availabiltiy of cyclotron-produced sup(132)Cs as a chloride salt of that positron-emitting radioisotope made it possible for us to demonstrate a significant selective affinity of malignant cells for the cesium ion. This suggests an important future biomedical role for sup(132)Cs which, by virtue of its positron emission and appropriate physical half-life (about 6.5 days), may have useful applications in cancer therapy, tumor imaging and in the early detection of malignancies.

1396 **(PB—85-209914/XAB) Handbook of glandular tissue doses in mammography. Final report March 1985.** Rosenstein, M.; Anderson, L.W.; Warner, G.G. (Food and Drug Administration, Rockville, MD (USA). Center for Devices and Radiological Health). Mar 1985. 20p. (HHS/PUB/FDA—85-8239). NTIS, PC A02/MF A01.

This Handbook contains data from which absorbed dose to glandular tissue in the breast (glandular tissue dose) can be estimated for mammographic procedures. The breast (excluding the skin) is a composite of adipose (i.e., fatty) and glandular (i.e., other soft) tissues. The glandular tissue is the tissue considered at risk for breast cancer. The intent of the Handbook is to permit the user to compute glandular tissue dose for various techniques in mammography as a function of breast compression, breast size, breast composition, and the quality of the x-ray beam. The method used to compute most of the basic data was a radiation transport calculation using a specialized version of a computer code developed at the Oak Ridge National Laboratory (Warner, 1973). The results of the calculations were then converted into the Handbook entries, using the specific characteristics of current mammographic techniques. Additional data are reproduced from previous work of others.

5507 Microbiology

REFER ALSO TO CITATION(S) 90, 276, 277, 284, 302, 1361

1397 **(BLG—567) Life history of Acetabularia acetabulum (= Mediterranea) in the laboratory and in nature.** Bonotto, S.; Arapis, G.; Paques, M. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Aug 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901912.

The life cycle of Acetabularia acetabulum (Dasycladaceae) is compared when grown under artificial or under natural conditions. New evidence is presented that in nature Acetabularia behaves as a "pluriannual" plant. 49 refs., 4 figs.

1398 **(DOE/ER/13248—2) Theory on extreme thermophilic anaerobes growing over temperature spans of 40°C or more. Progress report, July 1984-June 1985.** Wiegel, J. (Georgia Univ., Athens (USA)). 1985. Contract FG09-84ER13248. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000227.

New isolates, Thermoanaerobacter ethanolicus and Methanobacterium thermoautotrophicum, were characterized with respect to their ability to grow over an extended temperature range of 40°. The temperature dependent synthesis of alcohol dehydrogenase as well as cellulose degradation were examined. 18 refs.

5509 Pathology

REFER ALSO TO CITATION(S) 1295

1399 (INIS-BR—294, pp vp) **Definition of relevant surface antigens involved in the interiorization of Trypanosoma cruzi in host cells.** Arruda, M.V.; Zingales, B.; Colli, W. (Sao Paulo Univ., Brazil). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

1400 (INIS-mf—9472, pp 104) **^{99}Mo interaction with normal erythrocyte membrane and in hereditary spherocytosis.** Marik, T.; Kselikova, M. (Ustav Hematologie a Krevni Transfuze, Prague (Czechoslovakia)); Bibr, B. (Izotopova Laborator Biologickych Ustavu CSAV, Prague (Czechoslovakia)); Brabec, V.; Lener, J. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

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5520 Public Health

REFER ALSO TO CITATION(S) 106, 480

1401 **(PB—85-186740/XAB) Health hazard evaluation report HETA 80-212-1474, Pacific Gas and Electric Company, San Francisco, California.** Pryor, P.D.; Coye, M.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1984. 40p. NTIS, PC A03/MF A01.

In August 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate the exposure to Pacific Gas and Electric employees from polychlorinated biphenyls (PCBs) during repair and overhaul of electrical devices and in receiving yards or depot where these electrical devices containing PCBs are stored. NIOSH conducted environmental and medical evaluations from September 1980 through February 1982. Based on the environmental air samples obtained at each of the survey sites, NIOSH determined that a health hazard did not exist at the various operations investigated. It was determined, however, that a potential health hazard did exist to PG&E's Decoto depot yard employees. This is based on: (1) wipe samples taken which indicated PCBs on the worker's skin, work surfaces, as well as PCB contamination found in various areas in the Decoto yard; and (2) elevated serum PCB values (which may indicate exposures to PCBs in the past). Recommendations are included in Section VIII of this report to assist PG&E in reducing those PCB exposures found at the receiving depot. Current information regarding PCDDs and PCDFs are also referenced in this report.

1402 **(PB—85-219947/XAB) Walk-through survey report: control technology for fermentation processes at Novo Biochemical Industries, Inc., Franklinton, North Carolina.** Martinez, K.F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). Sep 1983. 14p. (CT—116-15A). NTIS, PC A02/MF A01.

A walkthrough survey of control technology for fermentation processes at Novo Biochemical Industries, Incorporated (SIC-2869), Franklinton, North Carolina was conducted in June, 1983. The company produced two industrial enzymes, alpha-amylase and amyl glucosidase, from microbial strains of Bacillus and Aspergillus. Engineering controls included enclosure of the production process and local exhaust ventilation of all bag dumping stations. Employee contact with the production process was minimal except for equipment maintenance and manual broth sample extraction. The majority of the large scale processes were computer controlled or monitored. All employees were required to maintain a clean work environment. The company used a computerized preventive-maintenance program. Routine industrial hygiene monitoring for active serosilized liquid enzymes was conducted. The company had a relatively complete medical and biological monitoring program. Appropriate personal-protective equipment was required in all departments of the facility. The company employed a standardized procedure for entering a deep tank reactor vessel. The author concludes that the company employs state of the art technology and provides a work environment that minimizes potential exposure to microorganisms, process chemical intermediates, and biological products. An indepth survey of the facility is recommended.

1403 **(PB—85-220812/XAB) Health-hazard evaluation report HETA 82-293-1482, 83-279-1482, United Association of the Plumbing and Pipefitting Industry, California Department of Housing, California Area.** Gorman, R.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1984. 37p. (HETA—82-293-1482,). NTIS, PC A03/MF A01.

A field survey of exposure to organic solvents during installation of plastic pipe (SIC-1711) in the San Francisco, California area was conducted in 1983. The survey was requested by a national plumber's union to evaluate exposure while installing plastic pipe. Breathing-zone samples were analyzed for methylethylketone, tetrahydrofuran, dimethylformamide, and cyclohexanone, components of commonly used plastic pipe adhesives. Fifty-nine local unions

throughout the US were surveyed to obtain general information on health complaints arising from plastic-pipe use. Fourteen plumbers were interviewed. Urine samples were obtained from six plumbers and analyzed for methylformamide, a dimethylformamide metabolite. The author concludes that overexposure of the plumbers to solvents cannot be documented; however, due to the large number of health complaints, exposure should be reduced. Recommendations include limiting the number of solvents in the adhesives and minimizing skin contact with the adhesives.

1404 **(PB—85-220945/XAB) Investigation of mortality from cancer and other causes of death among workers employed at an east Texas chemical plant.** Sweeney, M.H.; Beaumont, J.J.; Waxweiler, R.J.; Halperin, W.E. (Robert A. Taft Labs., Cincinnati, OH (USA)). Oct 1984. 22p. NTIS, PC A02/MF A01.

A historical prospective mortality study of chemical workers was conducted. The purpose of the study was to evaluate a suspected increase in deaths due to brain cancer and multiple myeloma. The cohort consisted of 2510 males who worked for at least 1 day at a chemical factory in East Texas between January 1, 1952 and December 31, 1977. The facility's major product was tetraethyllead. The cohort was traced through company, union, Social Security Administration, Internal Revenue Service, and state records. Death certificates were obtained from state vital statistics offices. The observed mortality was compared with predicted rates for all United States males. The authors conclude that no statistically significant increase in site specific mortality from cancer occurred. The small excess observed for brain and other cancers may have been due to chance associations.

1405 **(PB—85-220952/XAB) Health-hazard evaluation report HETA 84-270-1494, Federal Energy Regulatory Commission, Washington, DC.** Schulte, P.A.; Moseley, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1984. 12p. (HETA—84-270-1494). NTIS, PC A02/MF A01.

A walkthrough and radiation survey at the Federal Energy Regulatory Commission (SIC-9631), Washington, DC was conducted in April and June, 1984. The evaluation was requested to determine whether cases of leukemia and Hodgkin's disease among employees were related to environmental factors. Two cases of leukemia and one of Hodgkin's disease had been reported. Personnel records were reviewed for the previous 5 years to determine if other cases of leukemia or Hodgkin's disease existed. Standardized incidence ratios were computed for the observed cases. The authors conclude that no statistically significant excess of leukemia and Hodgkin's disease exists among employees. The observed cases are not environmentally related. No environmental or medical surveillance recommendations are given.

1406 **(PB—85-222875/XAB) Industrial-hygiene characterization of commercial applications of genetic engineering and biotechnology.** Elliott, L.J.; Carson, G.; Pauker, S.; West, D.; Wallingford, K. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Sep 1983. 43p. NTIS, PC A03/MF A01.

Walkthrough surveys of six companies involved in research and development of recombinant DNA techniques applicable to fermentation processes (SIC-7391) were conducted. Engineering controls at the sites included general and local ventilation systems, gas filtration, waste-products control, biological safety cabinets, access barriers, and room surfaces that met National Institutes of Health guidelines for working with contaminants. Five companies regularly tested and certified biological safety cabinets and walking hoods, and monitored the autoclaves. Four companies had guidelines for safe work practices and detailed plans for emergencies and laboratory accidents. Three facilities had industrial hygiene programs. All facilities had medical programs, but these varied in objectives, essential elements, and application. The authors note that the companies that were new to the field of fermentation technology were less sophisticated in their approach to occupational health and safety than the more-experienced companies. Recommendations include: establishing medical-surveillance programs with preemployment and periodic medical examinations and a serological monitoring system; implementing a systematic preventive-maintenance system for agitator seals; using control and pressure-relief valves; installing equipment safeguards; and establishing a registry of all work employed in recombinant DNA processes.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 1408

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 1359

1407 **(AD-A—155260/3/XAB) Predictive model of electron-beam-induced flashblindness. Final report, November 1983-October 1984.** Miller, N.; Wheeler, T.G. (Air Force School of Aerospace Medicine, Brooks AFB, TX (USA)). Mar 1985. 22p. (USAFSAM-TR—84-35). NTIS, PC A02/MF A01.

The spectral characteristics of the Cherenkov radiation have been evaluated and converted to equivalent retinal irradiance from external sources. On the basis of the conversion, electron fluxes have been estimated for 2-sec recovery times from flashblindness. The electrons are assumed to have energies greater than 6 MeV and to be delivered in one or more bursts of 1 microsecond each over 1 sec. It is important to note that very little data exists on recovery times as short as 2 sec for either photopic and scotopic conditions. This situation is a direct result of the lack of definition of the critical tasks and their sensitivity to an interruption of background adaptation. The Cherenkov radiation produced within the eye by relativistic electrons can be compared to light from external sources by the relationships: 1 rad approx. = 4.6 scotopic td-sec and 1 rad approx. = 0.55 photopic td sec. Based on these conversion factors, the following estimates can be derived by extrapolation from existing data: (1) Absolute threshold is equivalent to the Cerenkov radiation from a 4.3-microrad electron beam and to a 0.5-mrad x-ray beam. (2) For low photopic levels of adaption (approximately 10 td), 100,000-rad electron beam would be required for a 2-sec recover time for foveal or parafoveal vision. (3) For the dark-adapted eye, a dose of 10 rads may cause a 2-sec interruption in the detection of low-contrast, peripheral targets.

1408 **(DOE/ER/60073—1) Recovery of shortgrass plains vegetation following irradiation, burning, scraping and rototilling. Final report, 21 June 1982-20 December 1984.** Fraley, L. Jr. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Sep 1985. Contract AC02-82ER60073. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001852.

Density data by species were collected during June 1982 and a visual estimate of the grass-sedge standing crop was made in September 1983. Additional density data were collected in June 1985. Recovery in the radiation zone of total lethality was faster than originally predicted with a significant amount of blue grama, the dominant climax species, now present. Recovery of burned and scraped plots was similar to plots heavily damaged by radiation. Recovery of rototilled plots was slower. Species specific differences were noted between scraped and rototilled plots indicating either a soil surface or a plant damage difference. Long term recovery can only be determined if the area is monitored for several more years. 5 refs., 2 tabs.

1409 **(DOE/EV/01105—317) Effects of mixed neutron-gamma beams in both sequential and simultaneous irradiation modalities on chromosomal aberrations of human peripheral blood lymphocytes in-vitro.** Blake, P.K.; DeLuca, P.M. Jr.; Pearson, D.W.; Meisner, L.F.; Gould, M.N. (Wisconsin Univ., Madison (USA). Dept. of Medical Physics; Wisconsin Univ., Madison (USA). State Lab. of Hygiene; Wisconsin Univ., Madison (USA). Radiobiology Research Lab.). 1984. Contract AC02-76EV01105. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000849.

Initial irradiations have been performed in preparation for testing the independent action hypothesis for chromosomal abnormality production between low- and high-LET radiation. Results of these irradiations are compared with typical dose response curves. Lessons learned and proposed experiments for the future are discussed. 25 refs., 3 figs.

1410 **(FRNC-TH—1570) Study of the radio restoration effects of some biochemical compounds on rice embryos (Oryza sativa L. var. Cigalon) irradiated with cobalt 60 gamma radiations.** Al Harithi, S. (Montpellier-2 Univ., 34 (France)). Jan 1982. 169p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE85752876.

Research work on improvement of mutagenesis experiment techniques with emphasis on an improved repair of potentially lethal damage induced by high gamma radiation doses in rice embryos. The protective and recovery effects of the following biochemicals were investigated: cytokinines; indolylacetic acid; glucose; glucose phosphate; ATP; ATP-MG^{++} complex; spermidine; cyclic AMP and cyclic GMP. Only ATP-MG^{++}, C-AMP and C-GMP were able to increase the survival fraction of lethally irradiated rice embryos.

1411 **(GSF—11/85) Proposal for derivation of limit values for skin contamination.** Schieferdecker, H.; Koelzer, W.; Henrichs, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Apr 1985. 22p. (In German). (GSF-S—1232). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752716.

From the primary limit value for the skin dose secondary limit values are derived for skin contamination which can be used in practical radiation protection work. In analogy to the secondary limit value for the maximum permissible body burden in case of incorporation, limit values for the 'maximum permissible skin burden' are calculated with the help of dose factors for application in case of skin contamination. They can be derived from the skin dose limit values. Considering that the skin is exposed to contamination but temporarily, in analogy to the annual limit on intake in case of incorporation a 'limit value of skin contamination' is derived for immediately removable contaminations and for one day of exposure, whereas with respect to non-removable contamination and taking into account the renewal of the skin, a limit value of annual skin contamination is defined for non-removable skin contaminations. An investigation level for skin contamination is assumed as a threshold above which defined measures must be taken. Regarding these measures not more than three times appropriate washing is recommended with the subsequent procedure determined by the level of residual contamination. The respective limit values are indicated for some radionuclides selected as examples (C-14, Co-60, Sr-90, Y-90, I-131, Cs-137, Ce-141, Pu-239).

1412 (INIS-BR—294, pp 34-40) **Genetics of amyloglucosidase production in Aspergillus niger and Aspergillus awamori.** Bonatelli Junior, R.; Umbuzeiro-Valent, G.; Masiero, M.; Vialta, A.; Calil, M.R. (Universidade Estadual de Campinas, Brazil). 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE86780033. (CONF-8408159—Vol.2).

From 4. Japan-Brazil symposium on science and technology; Rio de Janeiro;Sao Paulo, Brazil (6 Aug 1984).

The results obtained with the isolation and characterization of mutants induced by irradiating 5-8 days old spores with ultraviolet light are presented. The modification in the amyloglucosidase accumulation, the allelic interactions of these mutations and the inhibitory effects of glycerol are reported. (M.A.C.).

1413 (INIS-mf—9353, pp 195) **Cellular bases of radiation-induced residual insufficiency in the haematopoietic system.** Wangenheim, K.H. v.; Peterson, H.P.; Feinendegen, L.E. 1984. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE86780077. (CONF-8405328—).

From 33. annual meeting of the Schutzkommission beim Bundesministerium des Innern; Bad Schwalbach, F.R. Germany (31 May 1984).

Following radiation exposure, man's survival and further well-being largely depends on the degree of damage to his heamatopietic system. Stem cells are particualarly sensitive to radiation. Over and beyond acute radiation damge, residual radiation damage is of significance since it reduces the performance of the haematopietic system and enhances the risk of leukaemia. Knowledge concerning cellular bases may be important for preventive and therapeutic measures. The measurement method presented is based on the fact that stem cells from transfused bone marrow will settle in the spleen of highly irradiated mice and be able to reconstruct the haematopietic system. Initally individual colonies can be observed which originate from a single stem cell and the proliferation of its descendants. Counting these colonies will give the number of stem cells. The reduction of the proliferation factor measured in the stem-cell quality test apparently is not due to a shift in the age structure of the stem cell compartment but to a damage which is located within a more or less substantial proportion of the stem cells themselves. This damage is the cause of stem cell descendant growth retarded on an average. It is probable that recovery observed after irradiation is brought about by less-damaged or undamaged stem cells replacing damaged ones. Initial results point to the fact that this replacement can be influenced by treatment after irradiation. (orig./MG).

1414 **(INIS-mf—9354) Computer-assisted detection of chromosomal aberrations for the purpose of establishing a biological dosimeter.** Ueberreiter, B. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1982. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE86780026.

Using a special high-resolution microscopy apparatus, digital light microscope images of human chromosomes were generated, and specific image processing algorithms were developed. The pattern recognition process for computer-assisted detection of specific, radiation-induced chromosomal aberrations comprises three steps: First, the orientation of the segmented objects is defined and corrected. For date reduction purposes, the individual chromosomes are reduced to a few basic types containing typical information. After a linear transformation step, the characteristic parameters thus derived form a parameter vector for statistical classification. The method was well suited for distinguishing normal chromosomes from chromosomal aberrations. 94% of the objects were identified correctly. To achieve even higher accuracy, quality standards were set by which suspectedly misclassified objects can be re-investigated in dialog by the human observer. Implementation of the program system for parameter extraction on a fast polyprocessor system opens up a realistic chance of reducing the computing time for dose estimates to about one hour. (orig./MG).

1415 **(INIS-mf—9355) In vivo studies on the experimental tumour sarcoma 180 in order to determine the therapeutic efficiency of gamma and neutron irradiation combined with hyperthermia and misonidazole.** Weber, H.J. (Duesseldorf Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 11 May 1982. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780027.

The influence of hyperthermia and/or Misonidazole on the therapeutic effect of gamma and neutron irradiation was investigated for the solid experimental tumour Sarcoma 180 in NMRI mice. Apart from the common biological parameters (tumour volume, growth retardation, tumour regression), also cellular effects and cell metabolism were studied in vivo by I-UdR lavelling without disturbing the tumour/host interaction. Sequential double labelling with ^{125}I-UdR and ^{131}I-UdR before treatment and measurement of rates of activity loss afterwards yielded information on cell metabolism and therapeutic efficiency. The influence of different therapies on the proliferation activity was assessed by injection of ^{125}I-UdR

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at different times after treatment, followed by measurements of the incorporation rate. The diagnostic value of the methods of measurement and the possibility of transferring the findings of animal experiments to clinical practice were investigated. (orig./MG).

1416 (INIS-mf—9366) **Early reactions of enzymes and metabolites of glycolysis at the myocardium after local irradiation.** Hoffmeister, N. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 18 Jun 1982. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE86780028.

The behaviour of enzymes, substrates and metabolites of clycolysis and the pentose-phosphate cycle was chemically investigated in guinea-pig myocardia after applying different radiation doses. The results indicate that already therapeutical doses of radiation result in essential metabolic alterations but also that the organ concerned endeavours to remedy the harmful influence at least partly. The investigations do not permit to define the actual mechanism underlying the modifications; however it is seen that changes in membrane permeability as well as alterations of effectors and inhibitors play an essential part. (orig.).

1417 (INIS-mf—9368) **Delayed radiation effects at the small and large intestine.** Wunder, S. (Duesseldorf Univ. (Germany, F.R.). Medizinische Fakultaet). 1982. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780029.

The work deals with 56 patients treated within a period of 15 years for delayed radiation damage to the intestine. Gynecologic carcinomas were most frequently the basic disease. By the time the complaints occurred, which mostly took the form of an ileus, the radiation therapy dated back 4 months to 38 years. The mean age of the patients was 60 years. The report points out the diagnostical problem as well as clinical, radiographic and histological findings. Especially hydronephrosis and renal failure were observed as additional radiation sequelae. Whenever possible, resection of the intestinal segment concerned should be carried through. The portion of radiological patients who attracted the disorder was of 72 per cent, with a lethal result in 37 per cent. Half the patients died from an imperfect anastomosis followed by peritonitis. In 16 per cent of the patients recidivations of the malignant basic disease occurred. Whether treatment of radiation damage of the intestine is successful depends on the care taken to give a diagnosis and on the assessment of the intestinal segment damaged. As the actinic injury tends to aggravate early surgical intervention is recommended. Because the treatment of malignant tumours by irradiation is partly quite successful, injuries to the intestine must to some extent be put up with. (orig./MG).

1418 (INIS-mf—9472, pp 99) **Model analysis of inactivation mechanism of ionizing particles in diploid cells.** Lokajicek, M. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav); Prokes, K. (Karlova Univ., Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi); Pridal, I. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

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1419 (INIS-mf—9472, pp 54) **Frequency of chromosome nondisjunctions following low radiation doses in mice.** Kalina, I.; Ondrussekova, A.; Brezani, P. (Univerzita P.J. Safarika, Kosice (Czechoslovakia). Katedra Vseobecnej Biologie). 1981. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1420 (INIS-mf—9472, pp 59) **Protection efficiency of mexamine-cystamine mixture against fractionated irradiation.** Kautska, J.; Misustova, J.; Hosek, B. (Ceskoslovenska Akademie Ved, Brno. Biofysikalni Ustav). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

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1421 (INIS-mf—9472, pp 68) **Adoptive transfer of cellular antitumor immunity in mice and ionizing radiation effect.** Kofranek, V.; Jandejsek, J.; Klener, V. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)); Koprivova, H. (Karlova Univ., Prague (Czechoslovakia). Biofyzikalni Ustav). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1422 (INIS-mf—9472, pp 78) **Changes in antitumor immunity in mice following ionizing radiation and cyclophosphamide.** Koprivova, H.; Dienstbier, Z. (Karlova Univ., Prague (Czechoslovakia). Biofyzikalni Ustav); Kofranek, V.; Jandejsek, J. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

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1423 (INIS-mf—9472, pp 80) **Superoxidedismutase activities in some tissues of cystamine-protected rats. I. Changes within one hour following exposure.** Kovarova, H.; Krizala, J.; Stoklasova, A.; Ledvina, M. (Karlova Univ., Hradec Kralove (Czechoslovakia). Lekarska Fakulta). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

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1424 (INIS-mf—9472, pp 81) **Altered frequency of food intake as radioresistance modifying factor. III. Time dependence of effect.** Kozubik, A.; Pospisil, M.; Netikova, J. (Ceskoslovenska Akademie Ved, Brno. Biofysikalni Ustav). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

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1425 (INIS-mf—9472, pp 85) **Radiosensitivity and level of superoxidedismutase in tissues.** Krizala, J.; Kovarova, H.; Stoklasova, A.; Ledvina, M. (Karlova Univ., Hradec Kralove (Czechoslovakia). Lekarska Fakulta). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1426 (INIS-mf—9472, pp 92) **Toxicity and radioprotective efficacy of Czechoslovak-made Gamafos (WR-2721).** Kuna, P. (Vojensky Lekarsky Vyzkumny a Doskolovaci Ustav J.E. Purkyne, Hradec Kralove (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1427 (INIS-mf—9472, pp 69) **Signal levels for measurement of internal contamination with whole body detector.** Kollar, J. (Krajska Hygienicka Stanica, Bratislava (Czechoslovakia)); Ondris, D. (Atomova Elektraren Bohunice, Jaslovske Bohunice (Czechoslovakia)). 1981. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1428 (INIS-mf—9472, pp 67) **Changes in activation of lymphocytes and mononuclear phagocyte system in mice following administration of ^{239}Pu and syngenous fibrosarcoma transplant.** Kofranek, V.; Jandejsek, J.; Bubenikova, D.; Jozifko, M. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)); Koprivova, H. (Karlova Univ., Prague (Czechoslovakia). Biofyzikalni Ustav). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1429 (INIS-mf—9472, pp 66) **Values of effective dose equivalent and of dose in selected organs for some radiographic examinations in CSR.** Kodl, O.; Kunz, E.; Snobr, J.; Bucina, I.; Kliment, V. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)); Mikusova, M. (Institut pro Dalsi Vzdelavani Lekaru a Farmaceutu, Prague (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1430 (INIS-mf—9472, pp 102) **Application of Ge(Li) spectrometry in personnel and environmental monitoring. II. Effect of global ^{137}Cs level in urine.** Malatova, I.; Bucina, I.; Michalek, V. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia). Ustav Hygieny Zareni). 1981. (In Czech). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780791. (CONF-8111162—Absts.).

From 1. congress of the Czechoslovak Society for Nuclear Medicine and Radiation Hygiene; Prague, Czechoslovakia (8 Nov 1981).

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1431 (NUREG/CR—1910) **Assessment of radiation doses from incandescent gas mantles that contain thorium.** O'Donnell, F.R.; Etnier, E.L. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract AC05-84OR21400. 100p. (ORNL—5815). NTIS, PC A05/MF A01 - GPO. File Number TI86000921.

Potential radiation dose equivalents were estimated for individuals and the population of the United States from annual distribution, use, and disposal of 25 million thorium-containing incandescent gas mantles. Under exposure scenarios developed from the best available information, total dose equivalents (sums of annual external dose equivalents and 50-year dose commitments from intakes during the year of radionuclides) to individuals were estimated to range from 0.01 pSv (1 prem) to 0.2 mSv (20 mrem) to total body, 0.02 pSv to 0.5 mSv to bone, and 0.01 pSv to 0.5 mSv to lungs. Collective dose commitments were estimated to range from 6 to 70 person-Sv (600 to 7000 person-rem), 20 to 400 bone-Sv, and 20 to 700 lung-Sv. Only ranges of potential dose commitments could be estimated because of uncertainties regarding nuclide behavior in mantles and some aspects of the personal behavior of some exposed persons. The uncertainties are discussed. 29 refs., 3 figs., 28 tabs.

1432 (NUREG/CR—2068) **CONDOS II - a tool for estimating radiation doses from radionuclide-containing consumer products.** O'Donnell, F.R.; Kocher, D.C.; Burke, O.W.; Clark, F.H. (Oak Ridge National Lab., TN (USA)). Nov 1981. Contract AC05-84OR21400. 95p. (ORNL/NUREG/TM—454). NTIS, PC E04/MF A01 - GPO. File Number TI86000932.

Includes 1 sheet of 48x reduction microfiche.

This report documents and explains how to use the CONDOS II methodology. Although designed for use in calculating radiation dose equivalents to man during the life span of a radioactive consumer product, the methodology can also be used as a general tool for radiation dose calculations. The methodology consists of two parts: (1) a general system for modeling radiation exposure events; and (2) a computer code that uses information from the model to calculate radiation dose equivalents from the situations modeled. Both the modeling system and the computer code are described and discussed. 12 refs., 8 figs., 6 tabs.

1433 (OAEP—1-109) **Effect of radiation on the nutritive value of post irradiated potatoes.** Pringsulaka, V. (Office of Atomic Energy for Peace, Bangkok (Thailand)). Dec 1983. 12p. (In Thai). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780031.

Harvested fresh potatoes of Spunta variety, were irradiated at 0, 60, 90, 120 and 150 gray and then stored at three temperatures; room temperature (30+-5 deg C) with 55-65 percent R.H., and 15 deg C and 10 deg C both with 85-95 percent R.H. The biochemical assay of total sugar, protein, and vitamin C were conducted for the determination of changing in nutritive value. The results of the experiment are as follows. Both non-irradiated and irradiated potatoes, stored at room temperature with 55-65 percent R.H., showed higher changing in percentage of total sugar and vitamin C, but only slightly changing in protein was observed. Furthermore, no significant difference was found in nutritive value between irradiated and non-irradiated potatoes stored at 15 deg C and 10 deg C with 85-95 percent R.H. 12 references.

1434 (OEVS-Mitteilung—2/85, pp 1-12) **Radioecology - nature and tasks.** Tschurlovits, M. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86780090. (CONF-8211212—).

From Fall meeting of the Austrian Study Group for Radioactivity Measurements in the Danube Region; Vienna, Austria (1 Nov 1982).

After a short review on the historical development, the requirements of the radioecology from the radiation protection point of view are discussed, where the most important point is identified in the assessment of dose. The properties of models as used in radioecological consideration are discussed and the requirements of the input parameters as well as the properties of the figures obtained from these calculations are considered.

1435 (SAND—85-2185C) **Radiological equipment for emergencies.** Stanley, A. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-8510164—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000432.

From Advanced management of radiation accidents; Albuquerque, NM, USA (3 Oct 1985).

A brief guide to training and equipment needed to effectively manage victims of radiation accidents. (DT)

1436 **(THAI-AEC—57) Sprout inhibition of onions by gamma irradiation.** Tiravat, K.; Chantharasakul, S. (Office of Atomic Energy for Peace, Bangkok (Thailand)). 1972. 28p. (In Thai). NTIS (US Sales Only), PC A03/MF A01. File Number DE86780032.

Freshly harvested and cured onions of Yellow Granex F_1 hybrid variety were irradiated at doses of 0, 3, 6, 9, 12, and 20 Krad and stored at different conditions, namely at room temperature (28 deg - 35 deg C, 55-70% R.H.); 20 deg C, 80-90% R.H.; 12 deg C, 65-75% R.H.; and at 3 deg C, 85-95% R.H. Storage at room temperature and at 20 deg C caused complete rottening in both irradiated and nonirradiated onions within 4 months, although the nonirradiated onions showed significantly higher percentage of sprouting than the irradiated ones. Relatively low percentage of rottening occurred in onions stored at 12 deg C and at 3 deg C. However, at 12 deg C the nonirradiated onions showed extremely high percentage of sprouting after storage for 3 months. The onions irradiated at 3-12 Krad showed neglegible percentage of sprouting after 6 months of storage at 12 deg C. No significant different was found regarding weight losses between irradiated and nonirradiated onions under the same condition. In addition, moisture contents of irradiated and nonirradiated onions stored at 12 deg C for certain periods were determined. 3 references.

1437 **(UCID—20548) Scenario and parameter studies on global deposition of radioactivity using the computer model GLODEP2.** Shapiro, C.S. (San Francisco State Univ., CA (USA); Lawrence Livermore National Lab., CA (USA)). Aug 1984. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001684.

The GLODEP2 computer code was utilized to determine biological impact to humans on a global scale using up-to-date estimates of biological risk. These risk factors use varied biological damage models for assessing effects. All the doses reported are the unsheltered, unweathered, smooth terrain, external gamma dose. We assume the unperturbed atmosphere in determining injection and deposition. Effects due to "nuclear winter" may invalidate this assumption. The calculations also include scenarios that attempt to assess the impact of the changing nature of the nuclear stockpile. In particular, the shift from larger to smaller yield nuclear devices significantly changes the injection pattern into the atmosphere, and hence significantly affects the radiation doses that ensue. We have also looked at injections into the equatorial atmosphere. In total, we report here the results for 8 scenarios. 10 refs., 6 figs., 11 tabs.

1438 **Pediatrics in the Marshall Islands.** Dungy, C.I.; Morgan, B.C.; Adams, W.H. (Univ. of California, Irvine). *Clinical Pediatrics (Philadelphia);* **23**: No. 1, 29-32(Jan 1984). Contract AC02-76CH00016.

The delivery of health care to children living on isolated island communities presents unique challenges to health professionals. An evolved method of providing longitudinal services to infants and children residing on islands of the Marshall Island chain - a central Pacific portion of the Micronesian archipelago - is presented. The difficulties associated with provision of comprehensive health care in a vast ocean area are discussed.

1439 **Structure of a psoralen-thymine monoadduct formed in photoreaction with DNA.** Peckler, S.; Graves, B.; Kanne, D.; Rapoport, H.; Hearst, J.E.; Kim, S.H. (Lawrence Berkeley Lab., CA). *Journal of Molecular Biology;* **162**: 157-172(1982).

A photoreaction product between calf thymus DNA and 8-methoxypsoralen, a naturally occurring psoralen, was hydrolyzed with acid to isolate a major species of the reaction, 8-methoxypsoralen-thymine monoadduct. The crystal structure of the monoadduct has been determined. The structure confirms the results of other spectroscopic studies and allows one to conclude or suggest that: (1) the photoreaction occurs preferentially at both T-A and A-T sequences in natural DNA; (2) the photocrosslink introduces a substantial kink in the DNA structure; (3) the configuration of the photoproduct is cis-syn at both ends of the psoralen; (4) the thymine and psoralen moieties remain planar even after the photoreaction; and (5) the angle between psoralen and thymine in the photoproducts is not fixed but has a limited range of flexibility.

5602 Thermal Effects

1440 **(SRD-R—275) Physiological and pathological effects of thermal radiation.** Hymes, I. (UKAEA Safety and Reliability Directorate, Culcheth). Sep 1983. 103p. United Kingdom Atomic Energy Authority, Wigshaw Lane, Culcheth, Warrington, England WA3-4NE. File Number TI85901928.

This report deals with man's response to abnormally high levels of thermal radiation. The early sections deal with the properties and biological roles of the skin in some detail as a basis for the definitions and descriptions of pathological damage. The estimation of hazard ranges in thermal radiation exposures requires a moderately accurate knowledge of the intensity and duration of the emitted flux. The (BLEVE) Boiling Liquid Expanding Vapor Explosion fireball conveniently meets this requirement as well as having the capability to inflict severe burn injuries over considerable distances. Liquid Petroleum Gas fireballs have been used as the source term for the thermal radiation calculations which predict threshold lethality and various categories of burn injury. Inevitably there are areas of uncertainty in such calculations, some contributory factors being atmospheric conditions, fuel container rupture pattern, type of clothing worn etc. The sensitivity of the predicted hazard ranges to these influential parameters is exemplified in several of the graphs presented. The susceptibility of everyday clothing to ignite or melt in thermal fluxes greater than about 70 kW/m^2 is shown to be a matter of some gravity since burning clothing can thwart escape and inflict serious, if not fatal, burns quite apart from injuries directly received from the incident radiation. The various means by which incident heat fluxes can be reduced or their effects mitigated are reviewed. Two major BLEVE case histories are discussed in some detail and the circumstances compared with those predicted by the theoretical calculations. 38 refs., 36 figs.

1441 **Chromatographic analysis of the adducts formed in DNA complexed with cis-diamminedichloroplatinum (II).** Rahn, R.O. (Oak Ridge National Lab., TN). *Journal of Inorganic Biochemistry;* **21**: 311-321(1984). Contract W-7405-ENG-26.

DNA (calf thymus) was reacted to completion with varying amounts of (/sup 195m/Pt)-cis-diamminedichloroplatinum (II) and then hydrolyzed in formic acid at 110°C for 15 min. The hydrolysate was then applied to an Aminex A6 cation-exchange column and eluted with potassium carbonate (0.01 M, pH11). For a molar ratio of bound Pt per nucleotide (r) of 0.06 or less, most of the radioactivity eluted in the form of two products identified as (1) a bifunctional homoadduct formed between Pt and two guanine residues, and (2) a bifunctional heteroadduct formed between Pt and a residue each of adenine and guanine. The amount of heteroadduct was about 20% of that of the homoadduct. When r was greater than r = 0.06, several additional peaks were observed, one of which was tentatively identified as a monofunctional adduct of guanine and Pt. For all r values, a portion of the Pt, amounting to — 20%, eluted in the void volume and may reflect a partial breakdown of the adducts during hydrolysis.

1442 **Contributions of unfrozen fraction and of salt concentration to the survival of slowly frozen human erythrocytes: influence of warming rate.** Mazur, P.; Rigopoulos, N. (Oak Ridge National Lab., TN). *Cryobiology;* **20**: 274-289(1983). Contract W-7405-ENG-26.

The general belief is that slow freezing injury is either the result of exposure to high salt concentrations or the result of excessive cell shrinkage. Ordinarily, salt concentration and the amount of liquid in the unfrozen channels are reciprocally related; but they can be separated within limits by varying the total concentration of solutes in the suspending medium while holding the mass ratio of additive to salt constant, and by then slowly freezing samples to various subzero temperatures. The authors have recently reported that when human red cells are frozen under these conditions and thawed rapidly, survival is more dependent on the unfrozen water fraction than it is on the salt concentration in that fraction. The present work compares these results with those obtained with slow thawing. While the general conclusion remains unaltered, slowly thawed cells were able to survive the freezing of a higher fraction

of extracellular water than were rapidly thawed cells. Calculations were made of the changes in cell volume during the equilibration with glycerol and the subsequent freezing involved in these experiments.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 82, 1012, 1341, 1342, 1359, 1420, 1422, 1426

1443 **(BNL—36881) Comparison of yields of several cultivars of field-grown soybeans exposed to simulated acidic rainfalls.** Evans, L.S.; Lewin, K.F.; Hendrey, G.R. (Brookhaven National Lab., Upton, NY (USA)). Feb 1985. Contract AC02-76CH00016. 12p. (CONF-850253—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000634.

From Peer review meeting on the EPA acid/precipitation and agriculture program; Upton, NY, USA (4 Feb 1985).

Rainfall acidity-response functions for crop yield and growth are necessary to predict the overall impacts of crop yields of ambient and/or anticipated levels of acidic rain. The experiment described herein was performed at Brookhaven National Laboratory to determine the effects of simulated rainfalls of pH 5.6, 4.4, 4.1, and 3.3 on seed-yields of four cultivars of field-grown soybeams. Soybeans were chosen because previous results suggested that this crop is sensitive to rainfall acidity and because they are economically important. Sixteen plots per treatment were used. This level of replication has been shown to be recommended in order to detect differences among treatments of approximately 10% if differences occur. Plants were grown under automatically moveable rainfall exclusion shelters which minimize changes in the plant's microclimate so that plants grown in this manner most closely mimick crops grown under standard agronomic conditions. Field-grown Amsoy soybeans shielded from ambient rainfalls and exposed to simulated rainfalls of pH 4.4, 4.1, and 3.3 exhibited yields 11.5, 10.4, and 11.7%, respectively, below yields of plants exposed to rain of pH 5.6. Asgrow 3127 soybean plants exposed to simulated rainfalls of pH 4.4, 4.1, and 3.3 had seed yields 14.5, 12.2, and 9.0%, respectively, below yields of plants exposed to pH 5.6 rain. Corsoy plants exposed to rainfalls of pH 4.4, 4.1, and 3.3 exhibited seed yeilds 13.7, 12.7, and 7.8% below yields of plants exposed to pH 5.6. Hobbitt plants experienced yield reductions of 9.2, 6.2, and 16.6% for pH levels of 4.4, 4.1, and 3.3 compared with controls. The decreases in seed mass per plant and per unit area for these four cultivars resulted mostly from a decrease in pod number per plant compared with minor or insigificant differences in seed number per pod, mass of individual seeds, and plant population densities. 41 refs., 2 tabs.

1444 **(CONF-851068—1) Assimilation and metabolism of polycyclic aromatic hydrocarbons by vegetation: an approach to this controversial issue and suggestions for future research.** Edwards, N.T. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001618.

From 10. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (21 Oct 1985).

Anthracene (ANTH), smaller and more water-soluble, was assimilated and translocated in bean plants more readily than benzanthracene (BaA), but ANTH was much more readily transformed than BaA. Both ANTH and BaA were translocated, however, 79% of the extractable ^{14}C compounds were found in stems and leaves were water-soluble metabolites produced in the roots. Bean plants assimilated and translocated much more readily from nutrient solution than from soil. 24 refs., 5 figs., 3 tabs.

1445 **(DPST—84-742) Bioassay testing of simulated effluent from the Defense Waste Processing Facility.** Fliermans, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 11 Dec 1984. Contract AC09-76SR00001. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001962.

Static acute bioassay tests were used to investigate the effect of the proposed effluent from the Defense Waste Processing Facility on juvenile bluegill sunfish, Lepomis macrochirus, and the lower food chain microorganisms present in Four Mile Creek. The simulated effluent contained $NaNO_3$ (25 mg/L), NaMnO (0.4 mg/L), $NaCHO_2$ (30 mg/L), $Na_2C_2O_4$ (20 mg/L) and WRICO ZC-830 (150 mg/L). The 96 hour acute toxicity testing for the bluegill sunfish indicated no toxicity for any of the tested concentrations more than 10 times the expected levels to be discharged into Four Mile Creek. These findings were consistent for all the pH values tested and regardless of the presence or absence of WRICO ZC-830. The bacterial studies indicated that the projected effluent would be toxic when the effluent reached concentrations twice that which has been projected or when the $NaCHO_2$ reaches 10X above the expected discharge levels. 1 ref., 28 tabs.

1446 **(INIS-mf—9369) In-vitro effects of tri-iodinated X-ray contrast media on blood coagulation, fibrinolysis and complement system.** Blanke, D. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 18 Jun 1982. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE86780035.

In-vitro experiments with Jodipamid, Jothalamat and Diatrizoat served the purpose of determining influences of contrast media on blood coagulation, fibrinolysis and the complement system. For all three contrast media investigated the effect noted was dose-dependent and was only brought about by concentrations higher than physiological ones. Liver-pathway Jodipamid was seen to have a much stronger effect than the two renal-pathway contrast media Jothalamat and Diatrizoat, which is probably due to the different protein binding capacities. In detail, the results with Jodipamid were as follows: a sharp fall in thrombinogen, a distinct decrease in fibrinogen both in the immunological and functional test, but only delayed decrease in complement factor C 4. Fibrinolytic fission products were found after applying the dose of 30 mM, as compared to 400 mM for the renal-pathway contrast media. Furthermore the functional tests (F I and F II) with Jothalamat and Diatrizoat showed only slight effects, the immunological ones (F I and C 4) none at all. The influence of the contrast media on factors I and II is interpreted by the author as an inhibition of fibrin polymerization. What seems to be the verification of fibrinolytic fission products is explained by a non-specific agglutination reaction, the decrease in C 4 by contrast-medium-induced protein denaturation. (orig./MG).

1447 **(NIOSH—84-116) Cadmium (CD). Current Intelligence Bulletin No. 42.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 27 Sep 1984. 14p. NIOSH-Robert Taft Lab., 4676 Columbia Parkway, Cincinnati, OH 45226. File Number TI85901684.

DDHS (NIOSH) Publication No. 84-116.

A recent epidemiological study has demonstrated a statistically significant excess of lung cancer mortality among workers exposed to cadmium oxide (CdO). A chronic inhalation exposure study with rats provides toxicological evidence that exposure to cadmium chloride ($CdCl_2$) aerosol can cause a dose-dependent incidence of malignant lung tumors. Based primarily on these data, the National Institute for Occupational Safety and Health (NIOSH) recommends that cadmium and its compounds be regarded as potential occupational carcinogens and that appropriate controls be used to reduce worker exposure. 31 refs.

1448 **(NP—86770026) Influence of Al and the heavy metals Fe, Mn, Zn, Cu, Pb, and Cd on development and efficacy of vesicular-arbuscular mycorrhiza in tropical and subtropical plants.** Fabig, B. (Goettingen Univ. (Germany, F.R.). Landwirtschaftliche Fakultaet). 8 Jul 1982. 175p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE86770026.

In greenhouse experiments the influence of Al and the heavy metals Fe, Mn, Zn, Cu, Pb, and Cd on the efficacy of VA-mycorrhizal fungi was tested with special regard to several soil pH levels and soil water regimes in different combinations. The most important results were: The inoculation led to a significantly better growth of all test plants in the presence of Al, Fe, Mn, Zn, Cu, Pb, and Cd up to a specific amount of the soil-applied element; beyond this specific limit the efficacy of the mycorrhiza was more or less inhibited depending on the element. In correlation with the growth, the nearly always better P uptake of the inoculated plants was impaired only by the highest toxic amounts of the elements. In com-

parison with the uninoculated plants, all the inoculated plants showed higher P and Pb concentrations. The mycorrhizal plants generally had significantly higher concentrations of the elements Al, Mn, Zn, Cu, and Cd in the roots than the uninoculated plants. Generally even toxic levels of Fe in the soil did not lead to higher Fe concentrations in the plants. Even the highest amounts of Al, Fe, Mn, Zn, and Cu did not cause microscopically visible injuries to the development of the mycorrhiza and did not impede the infection. Only the toxic levels of Pb led to a decrease of the infection rate of about 50%. Pb and Cd were the reason for morphological changes of the different developmental phases of the fungus. High amounts of Pb induced an increased formation of vesicles. The highest amounts of Cd were accompanied by the crowded occurrence of arbuscules.

1449 **(NUREG/CR—4382) Concentrations of uranium and thorium isotopes in uranium millers' and miners' tissues.** Wrenn, M.E.; Singh, N.P.; Paschoa, A.S.; Lloyd, R.D.; Saccomanno, G. (Utah Univ., Salt Lake City (USA). Radiobiology Lab.). Sep 1985. 57p. NTIS, PC A04/MF A01 - GPO. File Number TI86900088.

The alpha-emitting isotopes of uranium and thorium were determined in the lungs of 14 former uranium miners and in soft tissues and bones of three miners and two millers. These radionuclides were also determined in soft tissues and bones of seven normal controls. The average concentrations in pCi/kg wet weight in 17 former miners' lungs are as follows: ^{238}U, 75; ^{234}U, 80; ^{230}Th, 79. Concentrations of each nuclide ranged from 2 to 325 pCi/kg. The average ratio of ^{238}U/^{234}U was 0.92, ranging from 0.64 to 1.06. The mean ratio of ^{230}Th/^{234}U was 1.04, ranging from 0.33 to 3.54. The near equilibrium between ^{230}Th and /sup 238,234/U indicates that the rate of elimination of uranium and thorium from lungs is the same in former uranium miners. The concentrations of ^{234}U and ^{238}U were highest in lung; however, the concentration of ^{230}Th in bones was either higher than or comparable to its concentration in lung. The concentration ratios of ^{230}Th/^{234}U in bone of uranium miners and millers measured in our laboratory have been compared with results predicted by ICRP-30 metabolic models. These results indicate that the ICRP metabolic models for thorium and uranium were only marginally successful in predicting the ratio of ^{230}Th/^{234}U in bones, and that effective release rate of uranium from skeleton may be more rapid than predicted by the ICRP model. 9 figs., 21 tabs.

1450 **(PB—85-220697/XAB) Work-place mixtures and lung-defense systems. Final report.** Rabovsky, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1983. 80p. NTIS, PC A05/MF A01.

The effects of diesel exhaust, coal dust, and n-alkanes on lung and liver enzymes were studied in rats. Male Fischer-344 rats were exposed by inhalation to 1 milligram per cubic meter (mg/m^3) diesel exhausts or 1 mg/m^3 coal dust alone or in combination 7 hours daily, 5 days per week for 2 years. Cytochrome-P-450 associated benzo(a)pyrene-hydroxylase (BaP hydroxylase) and 7-ethoxycoumarin-o-deethylase activities were assayed in lung and liver microsomes after 3, 6, or 24 months. Sprague-Dawley-rats that had been pretreated with 0 or 80 mg per kilogram beta-naphthoflavone (BNF) were exposed to 0 to 2 millimolar (mM) concentrations of six straight-chained alkanes. Enzyme activities in lung and liver microsomes were determined. Diesel exhausts plus coal dust caused a slight, statistically insignificant, reduction in lung BaP hydroxylase activity. No other changes in lung and liver activities were observed. In non BNF pretreated rats, liver enzyme activities were decreased by 2mM alkanes, maximal decreases of 79 and 72%, respectively, occurring with n-octane. Lung enzyme activities were not affected. In BNF pretreated rats, lung o-deethylase activity was decreased by 44% by n-octane. The author concludes that enzyme sensitivity depends on the alkane.

1451 (PSW—58, pp 608) **Response of Adenostoma fasciculatum and Ceanothus greggii nitrogen and phosphorus.** Jow, W.M.; McMaster, G.S.; Kummerow, J. (San Diego State Univ., CA). Jun 1982. NTIS, PC A99/MF A01. File Number DE85011082. (CONF-8106339—).

From Symposium on dynamics and management of Mediterranean-type ecosystems; San Diego, CA, USA (22 Jun 1981).

The importance of nutrient availability in altering carbon allocation and growth of Mediterranean scrub species has frequently been stressed but rarely tested. Nitrogen (80 kg/ha) and phosphorus (40 kg/ha) were applied in the early spring of 1978 to a 23-year-old stand dominated by Adenostoma fasciculatum and Ceanothus greggii var. perplexans to examine the effects of N and P additions on biomass production and carbon allocation of the two dominant species.

1452 (PSW—58, pp 621) **Ponderosa and Jeffrey pine foliage retention indicates ozone dose response.** Miller, P.R.; Van Doren, R.E. (Dept. of Agriculture, Riverside, CA). Jun 1982. NTIS, PC A99/MF A01. File Number DE85011082. (CONF-8106339—).

From Symposium on dynamics and management of Mediterranean-type ecosystems; San Diego, CA, USA (22 Jun 1981).

Ozone is the component of photochemical air pollution responsible for damage to tree species comprising the mixed conifer and pine types of southern Sierra Nevada and southern California mountains. In these forests ponderosa pine (Pinus ponderosa (Laws.) and Jeffrey pine (P. Jeffreyi Grev. and Balf.) are the most sensitive to ozone. The purpose of this study was to examine needle injury symptom development leading to premature senescence and abscission as a function of ozone dose and intraspecific variation of ozone sensitivity.

1453 **(STEV-BF—84-1) Effects of gasoline, M15, methanol and ethanol on plants, soil and waterorganisms. A summary.** Laveskog, A.; Fondelius, M.; Lindblad, C.; Jansson, H. (Statens Energiverk, Stockholm (Sweden)). Dec 1983. 108p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752725.

A field study of the effects of the fuel was made on a meadow during summer 1982. Follow-up studies were made during 1983. The toxic effects of methanol and ethanol on the plants were much less severe than those from gasoline and M15. No serious disturbances were noted on the microbiological life in the soil. Studies of fuel spills in marine environment have been initiated.

1454 **(UCRL—92663) Predicting and managing the potential health risks of sour-gas wells.** Layton, D.W.; Cederwall, R.T. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 13p. (CONF-851160—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001580.

From Air Pollution Control Association Pacific Northwest international section annual meeting; Calgary, Canada (13 Nov 1985).

The development of sour-gas resources in Canada and the United States has prompted concerns about the potential occupational and public health risks of accidental gas releases from wells and pipelines. In this paper we examine methods to assess and manage the health risks of sour-gas wells. We present data and models that we have used to quantify the risks of sublethal and life-threatening exposures to hydrogen sulfide accidentally released from wells located in western Wyoming. 17 refs., 3 tabs.

1455 **Cadmium-induced lung injury: cell kinetics and long-term effects.** Martin, F.M.; Witschi, H.P. (Oak Ridge National Lab., TN). *Toxicology and Applied Pharmacology;* No. 2, 215-227(15 Sep 1985).

The effects of exposure to $CdCl_2$ aerosols followed by hyperoxia were studied in mouse lung. Special emphasis was placed on analysis of cell proliferation following injury. Male Balb/c mice were exposed to aerosols of 4.9 micrograms Cd/liter for 1 hr while controls were exposed to water aerosols. Immediately after, half of each group was placed in 80% O_2 for 6 days, while the rest were left in room air. Three endpoints were used to assess lung injury; measurement of hydroxyproline, [^{14}C]thymidine incorporation into DNA, and histopathology. Parenchymal and bronchiolar labeling indices were determined following autoradiography. A 1-hr exposure to $CdCl_2$ aerosols caused marked cell proliferation in the lung with the peak of cell labeling occurring at Day 5. In animals exposed to both $CdCl_2$ + 80% O_2, the cell labeling peak was delayed until Day 9. Cell differentiation studies showed a delay in the peak

of type II epithelial cell and endothelial cell division when $CdCl_2$ exposure was followed by the 80% O_2 treatment. On Day 15 most of the labeled cells were identified as interstitial cells in both treated groups. Bronchiolar cell labeling was suppressed at the early time period in the Cd + O_2 group. With time, the histologically visible lung lesions tended to resolve in animals exposed to $CdCl_2$ or $CdCl_2$ and 80% O_2, whereas total pulmonary hydroxyproline remained at all times (3, 6, and 12 months) significantly higher in Cd-treated animals when compared to controls. It was concluded that acute lung injury by a toxic inhalant can be amplified if there is an initial delay in pulmonary cell proliferation following an acute insult.

1456 Rapid detection of DNA-damaging agents using repair-deficient CHO cells. Hoy, C.A.; Salazar, E.P.; Thompson, L.H. (Lawrence Livermore National Lab., CA). *Mutation Research;* **130**: 321-332(1984). Contract W-7405-ENG-48.

A screening method is introduced to detect and classify DNA-damaging agents using DNA repair-deficient strains of Chinese hamster ovary cells. Differential cytotoxicity (relative growth) of the mutant cells compared to the wild-type cells was interpreted as a measure of lethal, potentially repairable damage to DNA. The assay consists of exposing the wild-type cells and three mutant strains to the test compound and using staining intensity to estimate growth after 72 h. The battery of mutants consists of two UV-sensitive strains (UV4 and UV5) that are deficient in different aspects of nucleotide excision repair, and strain EM9, which is defective in DNA-strand-break rejoining. The assay was highly reproducible, and the magnitude of the differential cytotoxicity response compared favorably with the amount of differential killing measured by colony-formation survival curves for several chemicals. 15 direct-acting and 7 metabolism-dependent agents that were expected to produce bulky, covalent DNA adducts were tested in the assay, and all produced a differential cytotoxicity response in at least two of the mutants. UV4 and UV5 showed a response to all of the test compounds whereas EM9 showed a response to 7 of the test compounds. Thus, the pattern of mutant responses presumably reflects the types of DNA damage produced by a compound. Results indicate the potential of a larger battery of mutants to classify a wide spectrum of chemicals according to the lesions they produce. 13 non-DNA damaging agents were also tested and none produced a differential cytotoxicity response, suggesting that this endpoint is specific for DNA damage. 53 references, 2 figures, 6 tables.

1457 Toxicity of sixteen metallic compounds in Chinese hamster ovary cells. Tan, E.L.; Williams, M.W.; Schenley, R.L.; Perdue, S.W.; Hayden, T.L.; Turner, J.E.; Hsie, A.W. (Oak Ridge National Lab., TN). *Toxicology and Applied Pharmacology;* **74**: 330-336(1984). Contract W-7405-ENG-26.

The toxicity of 16 metal salts to Chinese hamster ovary (CHO) cells was determined by measuring the cloning efficiency (CE) of CHO cells after exposure to the metals. CHO cells differed by a factor of 10^5 to 10^6 in their toxic response to these metal salts. While Cd(II) was the most toxic ion, Mg(II) exhibited the least toxicity based on either CE_{50} (concentration required to reduce the CE to 50%) or D_0 (concentration increment which reduced the CE by 63%). On the basis of CE_{50}, the toxicity ranking was Ag > Tl for monovalent metals, Cd > Zn > Hg > Co > Cu > Mn > Ni > Be > Pd > Sr > Mg for divalent metals, and In > Rh > Y for trivalent metals. A similar ranking was found for D_0. For the 11 divalent metals, correlations of CE_{50} and D_0 in the CHO cell assay and the Pearson-Mawby softness parameter for metals (σ/sub p/) were reasonably strong. A good correlation exists between the results of this study on the toxic response in CHO cells and published data on toxicity in mice and Drosophila. It appears that the CHO cell cloning assay may be useful in preliminary screening of metallic compounds as an indicator of their predicted toxicity in higher organisms.

1458 Biological effects of dyes on bacteria. VI. Mutation induction by acridine orange and methylene blue in the dark with special reference to Escherichia coli WP6 (polA1). Webb, R.B.; Hass, B.S. (Argonne National Lab., IL). *Mutation Research;* **137**: 1-6(1984). Contract W-31-109-ENG-38.

Acridine orange (AO) and methylene blue (MB) in the dark were shown to be weak to moderate mutagens (induction of resistance to T5 phage) in repair-deficient strains of Escherichia coli B/r. However, strain WP2, (wild-type) was not mutated by AO in the dark, in confirmation of earlier data. The presence of 2 μM AO reduced by 41% the spontaneous mutation rate in strain WP2, from 4.1 to 2.4 mutants/10^8 cells/generation. In the polymerase I-deficient strain WP6 (polA1), 2 μM AO increased the mutation rate in the dark 14-fold. It is proposed that both spontaneous and AO-induced mutagenesis in the absence of light occur at the site of semi-conservative DNA replication. If the intercalation mechanism for the effects in the absence of light is valid, the wild-type strain (WP2) may be resistant to frameshift mutagenesis induced by intercalated compounds, while the polymerase I-deficient strain (WP6) may be highly susceptible to the presence of an intercalated dye such as AO at the DNA-replication fork. MB and AO likely act through different mechanisms since MB is only a moderate mutagen in strain WP6 and the other repair-deficient strains tested.

1459 Reactions of corn root tissue to calcium. de Quintero, M.R.; Hanson, J.B. (Univ. of Illinois, Urbana). *Plant Physiology (English Translation);* **76**: 403-408(1984). Contract AC02-76EV00790.

Washing corn (Zea mays L.) root tissue in water causes loss of about one-third of the exchangeable Ca^{2+} over the first 10 to 15 minutes. Upon transfer to K^+-containing solutions, the tissue shows a short period of rapid K^+ influx which subsequently declines. Addition of 0.1 millimolar Ca^{2+} decreases the initial rapid K^+ influx, but increases the sustained rate of K^+ and Cl^- uptake. It was confirmed that 0.1 millimolar Ca^{2+} is more effective than higher concentrations for the initial inhibition, and that Mg^{2+} will substitute. The inhibition arises from a mild shock affect of restoring Ca^{2+}. With 0.1 millimolar Ca^{2+} net H^+ efflux is blocked for 10 to 15 minutes and the cells are depolarized by about 30 millivolts. However, 1 millimolar Ca^{2+} rapidly produces increased K^+ influx and blocks net H^+ efflux for only a few minutes; blockage is preceded by a brief net H^+ influx which may restore and increase ion transport by reactivating the plasmalemma H^+-ATPase. Stimulation of electrogenic H^+-pumping with fusicoccin eliminates the shock responses and minimizes Ca^{2+} effects on K^+ influx. Fusicoccin also strongly decreases Ca^{2+} influx, but has no effect on Ca^{2+} efflux. Ice temperatures and high pH decreased Ca^{2+} efflux, but uncoupler and chlorpromazine did not. It is suggested that the inhibitory and promotive actions of Ca^{2+} are manifested through decreases or increases in the protonmotive force. 29 references, 11 figures, 1 table.

1460 Sulfur cycling in forests. Johnson, D.W. (Oak Ridge National Lab., TN). *Biogeochemistryy (English Translation);* **1**: 29-43(1984). Contract AC05-84OR21400.

Sulfur is essential for the production of certain amino acids in plants. As amino acid sulfur is the major form of sulfur in trees, there is a strong relationship between organic S and organic N in tree tissue. Sulfur deficiencies occur in parts of southeastern Australia and northwestern North America, remote from pollutant inputs. Since biological S requirements of forests are modest (<5 kg x ha^{-1} yr^{-1} for net vegetative increment), atmospheric S inputs in polluted regions (10-80 kg x ha^{-1} x yr^{-1}) often exceed not only the forest ecosystem S requirement but also its ability to biologically accumulate S. There is some increase in the SO_4^{2-}-S content of forest vegetation in response to elevated atmospheric S inputs, but this capacity is apparently easily saturated. Soil SO_4^{2-} adsorption is often the dominant feature of S cycling in polluted ecosystems and often accounts for net ecosystem S accumulations.

1461 Analysis of SILVA: a model for forecasting the effects of SO_2 pollution and fire on western coniferous forests. Kercher, J.R.; Axelrod, M.C. (Lawrence Livermore National Lab., CA). *Ecological Modelling;* **23**: 165-184(1984). Contract W-7405-ENG-48.

A forest succession simulator, SILVA, had been developed for the mixed-conifer forest type of the Sierra Nevada, California, to simulate the effects of SO_2 and fire on forest dynamics. SILVA was developed by extensively modifying a northeastern US simulator. The state variables of the model are the diameters at breast height (dbh) of each tree on a forest stand. Ponderosa pine is found to be a relatively stable dominant for the site used in the simulations. White fir and sugar pine are relatively stable subordinate spe-

cies. Incense-cedar shows a slowly fluctuating time-series. Sensitivity analyses suggest that parameters can often produce a relative effect on basal area larger than their relative change. Factors affecting fire induced mortality are of lesser importance. The effects of competition change the relative magnitude of the calculated sensitivities also change during the time course of the simulation. Relative rankings of parameters according to their sensitivities during the time course of the simulation. Those parameters that exhibit large changes in sensitivity are also important in determining the outcome of competition. The authors investigated the convergence of the means of the time series of each species. The dominant ponderosa pine converged relatively rapidly with the number of runs. The subordinate species such as white fir converged much more slowly.

1462 **Acute toxicity of a synthetic oil, aniline and phenol to laboratory and natural populations of chironomid (Diptera) larvae.** Franco, P.J.; Daniels, K.L.; Cushman, R.M; Kazlow, G.A. (Oak Ridge National Lab., TN). *Environmental Pollution, Series A: Ecological and Biological;* **34**: 321-331(1984). Contract W-7405-ENG-26.

The acute toxicity of a water-soluble fraction of a coal-derived oil and two of its components, aniline and phenol, to larvae of four chironomid species was determined in 48-h bioassays. Three species, Clinotanypus pinguis, Einfeldia natchitocheae and Tanypus neopunctipennis, were collected from natural populations and the fourth, Chironomus tentans, was reared in laboratory culture. Bioassay data were examined using weighted least squares and probit analyses. The LC_{50} values calculated from regression equations for the water-soluble fraction ranged from 1.1% for E. natchitocheae to 2.0% for C. pinguis; for aniline, 287 mg liter^{-1} for T. neopunctipennis to 442 mg liter^{-1} for E. natchitocheae; and for phenol, 73 mg liter^{-1} for T. neopunctipennis to 187 mg liter^{-1} for C. tentans. Comparisons from sensitivity analyses revealed that the closer the taxonomic relationship between species, the more similar the response to a given toxicant. The data suggest that the laboratory population may be representative of natural midge populations in bioassays. 29 references, 3 figures, 2 tables.

1463 **Enhancement of 1,2-dimethylhydrazine-induced large bowel tumorigenesis in Balb/c mice by corn, soybean, and wheat brans.** Clapp, N.K.; Henke, M.A.; London, J.F.; Shock, T.L. (Oak Ridge Associated Universities, TN). *Nutrition and Cancer;* **6**: No. 2, 77-85(1984). Contract W-7405-ENG-26.

This study was designed to determine the effects of four well-characterized dietary brans on large bowel tumorigenesis induced in mice with 1,2-dimethylhydrazine (DMH). Eight-week-old barrier-derived male Balb/c mice were fed a semisynthetic diet with 20% bran added (either corn, soybean, soft winter wheat, or hard spring wheat) or a no-fiber-added control diet. Half of each group was given DMH (20 mg/kg body weight/week, subcutaneously for 10 weeks) beginning at 11 weeks of age. Surviving mice were killed 40 weeks after the first DMH injection. Tumors were not found in mice not subjected to DMH. In DMH-treated mice, tumors were found almost exclusively in the distal colon. Tumor incidences were as follows: controls, 11%; soybean group, 44%; soft winter wheat group, 48%; hard spring wheat group, 58%; and corn group, 72%. Tumors per tumor-bearing mouse ranged from 1.4 to 1.6, except in the corn group, which had 2.1. A positive correlation was found between percentage of neutral detergent fiber in the brans and tumor incidences but not between the individual components of cellulose, hemicellulose, or lignin. The enhancement of DMH-induced large bowel tumorigenesis by all four bran types may reflect a species and/or mouse strain effect that is bran-source related. These data emphasize the importance of using well-defined bran in all fiber studies.

1464 **Benzene inhalation produces leukemia in mice.** Cronkite, E.P.; Bullis, J.T.; Inoue, E.; Drew, R.T. (Brookhaven National Lab., Upton, NY). *Toxicology and Applied Pharmacology;* **75**: 358-361(1984). Contract AC02-76CH00016.

Female C57B1/6 mice were exposed to 100 ppm benzene 6 hr/day, 5 days/week for 16 weeks and then held for lifetime observation. Sixty-four weeks after commencement of the study, 10 of 90 exposed mice had died as opposed to only 1 of 88 controls. Of the 10 exposed mice that died, 6 had thymic lymphomas, 2 had unspecified lymphomas, 1 was killed when moribund and found leukemia-free, and 1 was undiagnosed due to autolysis and partial cannibalization. The single dead control animal did not have lymphoma or leukemia. These data provide proof of the leukemogenicity of benzene in female C57B1/6 mice.

1465 **Experimental studies of early infaunal recovery as a measure of marine sediment contamination.** Vanderhorst, J.R. (Battelle, Marine Research Lab., Sequim, WA). *Coastal Ocean Pollution Assessment News;* **3**: No. 2, 19-20(1984).

Trays of uncontaminated intertidal sediments from Sequim Bay and Protection Island, Washington, initially purged of infaunal organisms, reached species compositions and densities comparable to those measured in sampling studies of similar habitats within a period of 15 months. Oil contaminated sediments were colonized by only about half the number of species as were otherwise matched but uncontaminated sediments. There was also a reduction in overall density for oil-treated sediments as compared to controls. The effects from chemical dispersed and undispersed sediment-borne Prudhoe Bay crude oil were evaluated. Significant effects on infaunal recovery (numbers and densities of species) were demonstrated for both chemically dispersed oil and undispersed oil. 5 references, 1 table.

1466 **Mutagenicity of mono-, di- and tri-nitropyrenes in Chinese hamster ovary cells.** Li, A.P.; Dutcher, J.S. (Inhalation Toxicology Research Institute, Albuquerque, NM). *Mutation Research;* **119**: 387-392(1983). Contract AC04-76EV01013.

1-Nitropyrene (1-NP), 1,3-dinitropyrene (1,3-DNP), 1,6-dinitropyrene (1,6-DNP), 1,8-dinitropyrene (1,8-DNP) and 1,3,6-trinitropyrene (1,3,6-TNP) were tested for mutagenicity in cultured Chinese hamster ovary (CHO) cells. Mutation at the hypoxanthine-guanine phosphoribosyl transferase gene locus was quantified. While 1-NP and 1,3-DNP had only marginal direct-acting mutagenicity, 1,6-DNP, 1,8-DNP and 1,3,6-TNP showed definite mutagenicity, with specific mutagenic activities of 8.1, 21 and 54 mutants/10^6 survivors/μg.ml^{-1} respectively. The mutagenicity of 1-NP increased with increasing concentrations of Aroclor-1254 induced liver homogenate (S9) in the treatment medium. However, S9 at all concentrations tested decreased the mutagenicity of 1,6-DNP and 1,8-DNP. S9 at low concentrations enhanced the mutagenicity of 1,3-DNP and 1,3,6-TNP and that at high concentrations decreased their mutagenicity. The positive mutagenic response of the nitropyrenes suggests that they are potentially carcinogenic, and that further research into their possible human health risk should be performed.

1467 **Dose-response effects of fluoride in mammalian species.** Smith, F.A. (Univ. of Rochester School of Medicine and Dentistry, NY). *Trace Substances in Environmental Health;* **17**: 142-154(1983). Contract AC02-76EV03490.

A number of deleterious effects have been attributed to the ingestion of fluoride, sometimes for good reason and sometimes with no good basis. Literature describing some of these effects has been reviewed and threshold doses for the effects are suggested. Fluoride absorbed into the systemic circulation is rapidly removed, in part by storage in the skeletal system and in part by excretion in the urine. Skeletal storage evident in x-ray films as increased density to the x-rays is seen in about 10% of persons who have used drinking water containing 8 mg F per liter (8 ppm) for long periods of time. No deleterious effects are seen at this level of F storage in the bone. In the kidney the renal status of a population using water containing 8 mg F was not different from that of a population in an area where there was 0.4 ppm F in the water supply. Decreased renal function has been reported in persons using water supplies containing 10 ppm F. In human subjects growth is unaffected by prolonged use of water supplies containing up to 6-8 mg F/l (6-8 ppm). Growth in most animal species is not affected at concentrations of 100 mg F/kg diet (100 ppm). However, cattle undergoing cycle pregnancy, gestation and lactation appear to be more sensitive and growth is adversely affected at more than 40 ppm F in the diet. For cardiovascular effects, prolonged use of a water supply

containing 2.5 mg F/l (2.5 ppm) was found not to increase the incidence of CVD.

1468 **Experimental studies on the phytotoxicity of acidic precipitation: the United States experience.** Jacobson, J.S. (Dept. of Energy, Washington, DC). pp 151-160 of Effects of acid precipitation on terrestrial ecosystems. Hutchinson, T.C.; Havas, M. (eds.). New York, NY; Plenum Press (1980).

From NATO conference on effects of acid precipitation on vegetation and soils; Toronto, Ontario, Canada (21-27 May 1978).

There are four major locations, Brookhaven and Oak Ridge National Laboratory, Corvallis Environmental Research Laboratory and Boyce Thompson Institute, where experimental research on direct effects of acidic precipitation on vegetation is performed. The major inorganic components of precipitation in the eastern USA (sulfate, nitrate, chloride, ammonium, calcium, magnesium, and potassium ions) either are benign or beneficial to plants at the concentrations occurring in rain and snow. The free hydrogen ion concentration of acidic precipitation is the one producing the most harmful effects on vegetation. The most frequently reported response to simulated acidic precipitation is the formation of lesions or zones of dead tissue on the upper epidermis of leaves often near stomata, trichomes, and vascular tissues. Collapse and distortion of epidermal cells on upper leaf surfaces is followed by injury to palisade cells and ultimately both surfaces of the leaf are affected. Changes in chemical composition of foliage produced by experimental exposures to acidic precipitation are now being investigated at Boyce Thompson Institute. Biological, chemical, environmental and cultural factors may have a substantial influence on plant responses to acid rain. Herbaceous species seem to be highly sensitive to the formation of foliar lesion and the foliage of deciduous trees is more susceptible than the needles of coniferous trees. Plant species in the eastern USA are exposed repeatedly to elevated ozone concentrations during the growing season and to elevated sulfur dioxide concentrations in specific localities. A chart was included with data showing maximum pH value producing injury to vegetation after direct contact with simulated acid rain. 20 references, 3 tables.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 1359

1469 **(DOE/PE/17056—T5) Fire protection review revisit No. 2, Sandia National Laboratories, Albuquerque, New Mexico.** Dobson, P.H.; Simmons, J.M.; Wallace, H.H. (Factory Mutual Research Corp., Norwood, MA (USA)). Oct 1985. Contract AC01-84PE17056. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001138.

This report summarizes findings of a fire protection review conducted during July 21-25, July 28-August 2, 1985, and August 19-23, 1985, at Sandia National Laboratories, Albuquerque, New Mexico. The visit included: (1) tour of the facility, (2) water tests, (3) review of records of testing and inspection of fire protection equipment, and (4) tests of selected fire protection equipment to verify equipment had been properly tested and inspected.

1470 **(NUREG/CR—1916) Risk comparison.** Coppola, A.; Hall, R.E. (Brookhaven National Lab., Upton, NY (USA)). Feb 1981. Contract AC02-76CH00016. 90p. (BNL-NUREG—51338). NTIS, PC A05/MF A01 - GPO. File Number TI86000911.

This report presents data for the comparison of societal risk from natural and man-made hazards. Only fatalities resulting from the hazards are used in the comparison, with the data and the comparative analysis taken from current literature. In comparing societal risks for most of the hazards, both expected values and frequency vs consequence curves are presented. For a subset of hazards, notably the power generation technologies (nuclear, coal, oil, and gas), which have not exhibited high consequence events (catastrophes), the comparisons are based on estimated expected values only. Individual risk data are presented in two ways, a probability of death within a year and the amount of life shortening of an average life span. 27 refs., 21 figs., 25 tabs.

58 GEOSCIENCES

1471 **(DOE/ER—0145/3) Summaries of physical research in the geosciences.** (USDOE Office of Energy Research, Washington, DC. Engineering, Mathematics and Geosciences Div.). Sep 1985. 161p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86001832.

The summaries in this document describe the scope of the individual programs and detail the research performed during 1983 to 1984. The Geosciences Research Program includes research in geology, petrology, geophysics, geochemistry, hydrology, solar-terrestrial relationships, aeronomy, seismology, and natural resource analysis, including their various subdivisions and interdisciplinary areas.

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 200, 202, 215, 1285, 1327

1472 **(EPRI-EA—4301) Field measurement methods for hydrogeologic investigations: a critical review of the literature. Final report.** Rehm, B.W.; Stolzenburg, T.R.; Nichols, D.G. (Residuals Management Technology, Inc., Madison, WI (USA)). Oct 1985. 321p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920026.

This report is both a critical literature review and a bibliography dealing with methods used in hydrogeological investigations. Particular emphasis is placed on assessing the accuracy, precision and applicability of subsurface measurement methods at utility solid residue disposal sites. This evaluation was based on available data in the literature. Personal and anecdotal experiences were rejected as a source of information. Where the data existed, comparisons of various monitoring and sampling methods are presented. The literature review clearly shows that a paucity of quantitative data has been generated with regard to the accuracy and precision of sampling methods. It also demonstrates the difficulties encountered in obtaining this information. Controlled laboratory experiments are necessary to sort out the effects of a multitude of environmental variables. Laboratory experiments have been successfully used to evaluate ground water sampling methods. However, for solids sampling, unsaturated zone monitoring, hydraulic conductivity testing and geophysical measurements, laboratory experiments are far more difficult to design. For these areas, field comparisons of methods provide an initial assessment of the most appropriate technology in a particular hydrogeologic setting. 40 figs., 30 tabs.

1473 **(NP—6900110) Map of DGGS publications with author and quadrangle indexes. Information Circular 23.** (Alaska State Dept. of Natural Resources, Anchorage (USA). Div. of Geological and Geophysical Surveys). Jul 1985. 62p. DGGS Publications, 3601 C St., Anchorage, AK 99510. File Number TI86900110.

The bibliography lists reports published by the Division of Geological and Geophysical Surveys. The reports are sorted by author and by location of the work. (ACR)

1474 **(PB—85-210003/XAB) Moessbauer analysis of Lewisville, Texas, archaeological site lignite and hearth samples. Environmental geology notes.** Shiley, R.H.; Hughes, R.E.; Cahill, R.A.; Konopka, K.L.; Hinckley, C.C. (Illinois State Geological Survey, Champaign (USA)). 1985. 17p. (IL/SGS/EGN—109). NTIS, PC A02/MF A01.

Prepared in cooperation with Southern Illinois Univ. at Carbondale.

The Lewisville site, located in Denton County on the Trinity River north of Dallas, Texas, was thought to provide evidence of the earliest human activity in the western hemisphere. Radiocarbon dates of 37,000 to 38,000 B.P. determined for the site in the late 1950s conflicted with the presence of a Clovis point, which would fix the age of the site between 11,000 and 11,500 B.P. It was hypothesized (Johnson, 1982) that Clovis people were burning lignite from nearby outcrops: lignite in hearth residues would give older than actual ages by radiocarbon dating. X-ray diffraction and instrumental neutron-activation analysis proved inconclusive; howev-

er, Moessbauer spectroscopy indicated that hematite, a pyrite combustion product, was present in the ash. From this evidence the authors conclude that there is some support for the hypothesis.

1475 **(RHO-C—20) Hanford groundwater modeling: review of sampling design methods.** Moore, S.F.; McLaughlin, D.B. (Resource Management Associates, Lafayette, CA (USA)). Jan 1979. Contract AC06-77RL01030. 74p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86001594.

This report is the third in a series of three documents which address the role of uncertainty in the Rockwell Hanford Operations groundwater model development and application program at the US Department of Energy Hanford site. The problem of designing field sampling networks to support Rockwell's groundwater modeling needs is formulated statistically. The general problem formulation allows both cost and accuracy factors to be incorporated into practical designs concerned with the location and the scheduling of field samples. Three methods for solving simplified versions of the general problem are reviewed and it is shown that sequential design procedures which iteratively maximize incremental information gain (or an equivalent performance measure) have a number of desirable characteristics particularly relevant to the Hanford situation. Recommendations for developing available design algorithms further and for exploring promising new methods are provided at the end of the report. 12 refs., 8 figs.

1476 **(SAND—84-7212) Investigations of sensitivity and uncertainty in some hydrologic models of Yucca Mountain and vicinity.** Jacobson, E.A.; Freshley, M.D.; Dove, F.H. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC04-76DP00789. 126p. (PNL—5306). NTIS, PC A07/MF A01; GPO Dep. File Number DE86002091.

The uncertainty in travel time for water through unsaturated and saturated zones of Yucca Mountain and vicinity was determined by considering uncertainty associated with input parameters to the hydrologic models of these zones. A first-order analysis was used to investigate uncertainty in water travel time through the unsaturated zone at Yucca Mountain, based on an analytic solution for water flow. Results of the investigation of uncertainty for the unsaturated zone indicated that uncertainty in the percolation estimate contributed significantly more to uncertainty in travel time than uncertainty in estimates of hydraulic conductivity. Monte Carlo and first-order approaches were used to investigate uncertainty in ground-water travel time for different cases that varied in the treatment of the input parameters to the hydrologic model of the unsaturated zone. Comparison of the Monte Carlo and first-order estimates of mean ground-water travel and travel time uncertainty in the saturated zone demonstrates that the first-order approach underestimated both the mean and variance of travel time for all considered. This underestimation suggests that the Monte Carlo approach should be used to estimate mean travel and its variance as well as the probability density distribution of travel time. A sensitivity study of ground-water travel time in the standard zone indicated that the zones with smaller transmissivity produced the largest influence in travel time for most cases. 31 refs., 40 figs., 19 tabs.

1477 **(TVA/ONRED/AWR—85/18) Floods on Duck River and Flat, Big Spring, Bomar, and Little Hurricane Creeks and Pettus and Holland Branches and unnamed tributaries to Bomar and Little Hurricane Creeks and Holland Branch in the vicinity of Shelbyville, Tennessee.** (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development). Apr 1985. 178p. NTIS, PC A09/MF A01. File Number DE85901872.

This flood hazard information report describes the extent and severity of the flood potential along selected reaches of the Duck River; Flat, Big Spring, Bomar, and Little Hurricane Creeks; Pettus and Holland Branches; and unnamed tributaries to Bomar and Little Hurricane Creeks and Holland Branch in the vicinity of Shelbyville, Tennessee.

1478 **(TVA/ONRED/AWR—85/24) Floods on Big Rock, Collins, and Snake Creeks and Capps, Loyd, and Snell Branches in the vicinity of Lewisburg, Tennessee.** (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development). Jun 1985. 87p. NTIS, PC A05/MF A01. File Number DE86900104.

This report describes the extent and severity of the flood potential along selected reaches of Big Rock, Collins, and Snake Creeks and Capps, Loyd, and Snell Branches in the vicinity of Lewisburg, Tennessee.

1479 **(USGS-CIRC—904-B) Geologic and hydrologic characterization and evaluation of the Basin and Range Province relative to the disposal of high-level radioactive waste. Part II. Geologic and hydrologic characterization.** Sargent, K.A.; Bedinger, M.S. (Geological Survey, Denver, CO (USA)). 1985. 36p. US Geological Survey, 604 S. Pickett Street, Alexandria, VA 22304. File Number TI85901877.

The geology and hydrology of the Basin and Range Province of the western conterminous United States are characterized in a series of data sets depicted in maps compiled for evaluation of prospective areas for further study of geohydrologic environments for isolation of high-level radioactive waste. The data sets include: (1) average precipitation and evaporation; (2) surface distribution of selected rock types; (3) tectonic conditions; and (4) surface- and ground-water hydrology and Pleistocene lakes and marshes. Rocks mapped for consideration as potential host media for the isolation of high-level radioactive waste are widespread and include argillaceous rocks, granitic rocks, tuffaceous rocks, mafic extrusive rocks, evaporites, and laharic breccias. The unsaturated zone, where probably as thick as 150 meters (500 feet), was mapped for consideration as an environment for isolation of high-level waste. Unsaturated rocks of various lithologic types are widespread in the Province. Tectonic stability in the Quaternary Period is considered the key to assessing the probability of future tectonism with regard to high-level radioactive waste disposal. Tectonic conditions are characterized on the basis of the seismic record, heat-flow measurements, the occurrence of Quaternary faults, vertical crustal movement, and volcanic features. Tectonic activity, as indicated by seismicity, is greatest in areas bordering the western margin of the Province in Nevada and southern California, the eastern margin of the Province bordering the Wasatch Mountains in Utah and in parts of the Rio Grande valley. Late Cenozoic volcanic activity is widespread, being greatest bordering the Sierra Nevada in California and Oregon, and bordering the Wasatch Mountains in southern Utah and Idaho. 43 refs., 22 figs.

1480 **(USGS-CIRC—904C) Geologic and hydrologic characterization and evaluation of the Basin and Range Province relative to the disposal of high-level radioactive waste. Part III. Geologic and hydrologic evaluation.** Bedinger, M.S.; Sargent, K.A.; Brady, B.T. (Geological Survey, Denver, CO (USA)). 1985. 31p. US Geological Survey, 604 S. Pickett Street, Alexandria, VA 22304. File Number TI85901876.

This report describes the first phase in evaluating the geology and hydrology of the Basin and Range Province for potential suitability of geohydrologic environments for isolation of high-level radioactive waste. The geologic and hydrologic factors considered in the Province evaluation include distribution of potential host rocks, tectonic conditions and data on ground-water hydrology. Potential host media considered include argillaceous rocks, tuff, basaltic rocks, granitic rocks, evaporites, and the unsaturated zone. The tectonic factors considered are Quaternary faults, late Cenozoic volcanics, seismic activity, heat flow, and late Cenozoic rates of vertical uplift. Hydrologic conditions considered include length of flow path from potential host rocks to discharge areas, interbasin and geothermal flow systems and thick unsaturated sections as potential host media. The Basin and Range Province was divided into 12 subprovinces; each subprovince is evaluated separately and prospective areas for further study are identified. About one-half of the Province appears to have combinations of potential host rocks, tectonic conditions, and ground-water hydrology that merit consideration for further study. The prospective areas for further study in each subprovince are summarized in a brief list of the potentially favorable factors and the issues of concern. Data compiled for the entire Province do not permit a complete evaluation of the favorability for high-level waste isolation. The evaluations here are intended to identify broad regions that contain potential geohydrologic environments containing multiple natural barriers to radionuclide migration. 13 refs., 14 figs.

1481 (USGS-OFR—84-371) Application of uranium-thorium systematics to rocks from the Lassen Dome Field, California. Trimble, D.A.; Clynne, M.A.; Robinson, S.W. (Geological Survey, Menlo Park, CA (USA)). 1984. 108p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900052.

^{238}U-^{230}Th disequilibrium systematics were applied to a suite of fifteen dacites, rhyodacites, and mafic inclusions from the Lassen dome field, Lassen Volcanic National Park, California. Chemical procedures were established and are reported for separation and purification of uranium and thorium from whole-rock samples and mineral separates. Activities of ^{230}Th, ^{232}Th, ^{234}U, and ^{238}U were determined by alpha spectrometry. Age determinations were made for five of the rhyodacite units using ^{230}Th-^{238}U isochrons. The determined ages range from 3600 to 57,000 years, and are in agreement with volcanic and glacial stratigraphy and with preliminary radiocarbon and K-Ar ages. The data support a origin for the intermediate and silicic rocks of the Lassen Volcanic Center by fractional crystallization of mantle derived mafic magmas in an open system. 24 figs., 8 tabs.

1482 (USGS-OFR—84-454-A) Statistical summaries of streamflow data in Oregon. Volume 2. Western Oregon. Friday, J.; Miller, S.J. (Geological Survey, Portland, OR (USA). Water Resources Div.). 1984. 256p. US Geological Survey, Box 25425, Denver, CO 80225. File Number TI86900050.

Statistical summaries of streamflow data at 212 streamgaging sites are presented in this report to aid in appraising the hydrology of river basins in western Oregon. Records for 21 gaging stations were compiled into separate periods owing to changes in regulation during the period of data collection. The periods before and after regulation are presented for comparison. A brief station description is given describing the physical and operational features for each gaging station. Following the station description are tables of monthly and annual flow statistics, flood frequency data, low-flow and high-flow frequency data, and flow-duration information. 5 refs., 1 fig.

1483 (USGS-OFR—84-613) January 1984 water levels, and data related to water-level changes, western and south-central Kansas. Pabst, M.E.; Dague, B.J. (Geological Survey, Lawrence, KS (USA)). 1984. 166p. US Geological Survey, Box 25425, Denver, CO 80225. File Number TI86900038.

This report provides hydrologic data related to water-level measurements made in about 1450 observation wells in western and south-central Kansas during January and February 1984. Water-level measurements are made in mid-winter of each year to minimize the effect of seasonal pumping. However, a few water-level measurements that are made in mid-winter of some years may reflect either the effects of recent pumping from the observation well or by nearby wells or the effects of barometric-pressure changes. Average water-level changes for the four reported areas were computed for various time intervals. In northwetern Kansas, the average water-level decline was 0.6 foot during 1983, and the average rise was 0.9 foot during 1982. The average annual water-level decline was 0.6 foot for the 18-year period from 1966-83. In west-central Kansas, the average decline was 0.7 foot during 1983, and 0.2 feet during 1982. For 1966-83, the average annual decline was 1.5 feet. In southwestern Kansas, the average water-level decline was 0.4 feet during 1983, and 1.8 feet during 1982. The average annual decline was 1.7 feet during 1966-83. In south-central Kansas, the average water-level decline was 0.2 foot during 1983, and 0.8 foot during 1982. The average annual decline was 0.4 foot during 1974-83. Water levels declined an average of 0.5 foot during 1983 throughout western and south-central Kansas. 2 figs., 1 tab.

1484 (USGS/WRI—84-4120) Sedimentologic history of the Loxahatchee River estuary, Florida. Wanless, H.; Rossinsky, V. Jr.; McPherson, B.F. (Miami Univ., FL (USA); Geological Survey, Tallahassee, FL (USA)). 1984. 64p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900044.

Short-term and long-term history of sedimentation in the Loxahatchee River estuary was evaluated based on field sampling and observations, as well as on laboratory analyses of core borings taken through the Holocene sedimentary sequences within the estuary basin. In the main body of the estuary away from sandbars, the sedimentary sequences were dominated by bioturbated mud, or mottled muddy sand, to depths of about 30 centimeters below the sediment surface and by interlayered sand and mud with high-organic content below the bioturbated zone. The biological reworking of the near-surface sediment is interpreted as the result of increased marine influences, possibly associated with "permanently" opening and maintaining Jupiter Inlet since the late 1940's and with altered freshwater runoff. Sedimentation rates based on radiocarbon dates have decreased from 0.69 millimeter per year about 7000 years ago to about 0.25 millimeter per year 1000 years ago. Although this trend is associated with a decrease in the rate at which sea level has been rising, sedimentation rates nevertheless have not kept up with rises in sea level. Other evidence indicates that sediment is being provided to the estuary at much higher rates than it is actually accumulating, and this suggests that dynamic physical processes of circulation and flushing are inhibiting rapid sediment accumulation. 15 refs., 31 figs., 5 tabs.

5802 Geophysics

REFER ALSO TO CITATION(S) 203, 424, 1282, 1282, 1473, 1481

1485 (DOE/SAN/12196—3) Three-dimensional mise-a-la-masse modeling applied to mapping fracture zones. Beasley, C.W.; Ward, S.H. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics; SEE CODE- 9520101 Utah Univ., Salt Lake City (USA). Earth Sciences Lab.). Jun 1985. Contract AC03-84SF12196. 115p. (ESL—143). NTIS, PC A06/MF A01; GPO Dep. File Number DE86002007.

A numerical scheme applying the method of integral equations has been developed for borehole-to-borehole and borehole-to-surface modeling of the apparent resistivity response of a thin conductive body in a half-space; the inhomogeneity simulates a fracture zone. The algorithm is applicable for the direct-current case when the buried electrode is either inside (mise-a-la-masse) or outside (near-miss) the body. In implementing the scheme, the integral equation is transformed into a matrix equation as a result of discretizing the inhomogeneity into rectangular subcells. All properties are assumed to be constant within each subcell. The rectangular subcells are used throughout execution of the algorithm. The computed surface and subsurface apparent resistivity responses are examined for similar bodies with different orientations: (1) vertical, (2) horizontal, (3) dipping at 60 degrees, and (4) dipping at 30 degrees. The different bodies produce apparent resisitivity cross-section plots which differ little from each other with the exception of orientation. 21 refs., 38 figs.

1486 (NUREG/CR—2095) Empirical analyses of near-source ground motion. Shakal, A.F.; Bernreuter, D.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1980. Contract W-7405-ENG-48. 67p. (UCRL—53028). NTIS, PC A04/MF A01 - GPO. File Number TI86000956.

The distance dependence of ground motion relationships derived from close-in data is very sensitive to the ambiguous interpretation of distance when the station is a source dimension or less from the fault. The choice of the method for measuring distance can have a dramatic impact on the resulting ground motion curves. The straightforward application of ground motion curves based on certain distance measures may lead to unconservative predictions of peak ground motion. The magnitude dependence of close-in peak ground motion data does not show evidence of a saturation, or decreased magnitude dependence, at large magnitudes. Neither is a saturation observed if the earthquake size, or strength, is parameterized by seismic moment. It is possible that this reflects an inadequate data set. Unusually high peak vertical accelerations recorded at close-in distances may be separated into two categories. In the first high vertical acceleration may be directly attributed to the source radiation. In the second the site sedimentary structure is the most important factor. In the latter case, the high vertical acceleration occurs in a vertically-polarized converted or channeled phase arriving between the P and S arrivals. The high vertical accelera-

tions recorded in the recent Imperial Valley and Coyote lake earthquakes are of this type. 25 figs.

1487 **(NUREG/CR—2103) Scaling and estimation of earthquake ground motion as a function of the earthquake source parameters and distance.** Bernreuter, D.L. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 79p. (UCRL—53020). NTIS, PC A05/MF A01 - GPO. File Number TI86000915.

In this report we review the various methodologies currently available to predict the near-source ground motion from an earthquake. The limitations of the various approaches are discussed in light of recently developed theory and recorded data. To overcome some of the limitations of available approaches, we develop improved rules for scaling between earthquakes. Ground-motion data obtained from salvo (line source) explosions are also investigated to gain insight into the appropriate form for the attenuation of peak acceleration and peak velocity. The scaling laws are combined with the appropriate attenuation relations and the data from the 1971 San Fernando and 1940 Imperial Valley earthquakes to obtain relations among the key source parameters: dynamic stress drop and equivalent radius of the highly stressed region, distance from the center of energy release, and peak ground acceleration and velocity. These relations are verified by comparing the predicted levels of ground motion to those actually recorded from a number of earthquakes, including the recent 1979 Imperial Valley and Coyote Lake earthquakes. The relations among earthquake magnitude, earthquake source parameters, and peak ground motion are discussed. 83 refs., 37 figs., 9 tabs.

1488 **(UCID—20522) Depth distributions of seismicity in the East San Francisco Bay Region.** Scheimer, J. (Lawrence Livermore National Lab., CA (USA)). Aug 1985. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001612.

Depth distributions of seismicity are given for nine seismic source zones in the Livermore Valley Region. The dataset used covers the time period from 1969 through 1982. Most seismicity, in all zones, occurs between the depths of 3.5 km and 15 km. 3 refs., 20 figs.

1489 **(UCID—20558) Preliminary evaluation of the utility of a large spacing electromagnetic loop-loop logging tool.** Harben, P. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001685.

This paper analyses the potential of using loop-loop large spacing downhole electromagnetic measurements for detection of clay zones within a tuff and alluvium matrix. A brief background on surface loop-loop electromagnetic methods is given followed by a section on source and receiver loop orientation. Measurement sensitivity is discussed followed by the modelling strategy used. The value of the loop-loop electromagnetic tool is assessed in terms of usefulness to containment evaluation. 4 refs., 13 figs.

1490 **(USGS-OFR—84-657) Noise analysis of the seismic system employed in the northern and southern California seismic nets.** Eaton, J.P. (Geological Survey, Menlo Park, CA (USA)). 1984. 48p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900046.

To come to grips with the complex problem of system noise in the seismic networks, a number of measurements and experiments were conducted to evaluate critical components of the system as well as to determine the noise characteristics of the system as a whole. The report includes: (1) an overview of noise sources in various parts of the system; (2) analysis of preamp noise versus combined modulator/discriminator noise; (3) network-wide analysis of noise from magnetic tape playbacks; (4) analysis of noise on low-gain channels; and (5) analysis of system noise during the automatic calibration cycle. 8 figs., 9 tabs. (ACR)

1491 **(USGS-OFR—85-377) Automatic program for the interpretation of two-dimensional gravity and magnetic anomalies.** Wagini, A. (Geological Survey, Menlo Park, CA (USA)). 1985. Contract A108-78ET44802. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001418.

This automatic inversion program for the interpretation of two-dimensional gravity and magnetic anomalies has been developed mainly in support of the US Geological Survey's effort to characterize potential radioactive-waste storage sites at the Nevada Test Site, Nevada. Determining subsurface shapes and extensions of geologic bodies necessitates extensive modeling of magnetic and gravity data. Geologic models for the source of magnetic or gravity anomalies are often developed by trial and error: an approximation is made to establish an initial model, the anomaly due to the model is calculated and compared with the observed anomaly, and the model is iteratively modified to improve the agreement between calculated and observed anomalies. The method presented is not a least-squares method like other methods developed during the last few years, but minimizes the sum of the squares of the residuals by varying only one variable (coordinate) at a time. Varying one variable at a time allows one to use all available information in the model calculation, which can essentially reduce the computation time. The objective of this program is to find the shape of geologic bodies when the physical parameters are known. Except for the outermost corners, only the z-coordinate of each corner-point is varied. The variation of only one variable at a time has the advantage that a large number of bodies and corner-points (in this program up to 50 bodies, each with up to 50 corner-points) can be used for the model calculation without solving a large matrix. This can be important, especially for smaller computers. The program is written in ANSI Standard FORTRAN 77 and is interactive; thus it requires little knowledge of the computer system and its editing facilities. 5 refs.

1492 **Interpretation of seismic reflection profiling data for the structure of the san andreas fault zone.** Feng, R.; McEvilly, T.V. (Institute of Geophysics, State Seismological Bureau, Peking). *Bulletin of the Seismological Society of America;* **73**: No. 6, 1701-1720(Dec 1983).

A seismic reflection profile crossing the San Andreas fault zone in central California was conducted in 1978. Results are complicated by the extreme lateral heterogeneity and low velocities in the fault zone. Other evidence for severelateral velocity change across the fault zone lies in hypocenter bias and nodal plane distortion for earthquakes on the fault. Conventional interpretation and processing methods for reflection data are hard-pressed in this situation. Using the inverse ray method of May and Covey (1981), with an initial model derived from a variety of data and the impedance contrasts inferred from the preserved amplitude stacked section, an iterative inversion process yields a velocity model which, while clearly nonunique, is consistent with the various lines of evidence on the fault zone structure.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 114, 115, 201, 1479, 1480

1493 **(DOE/ER/10763—4) Distribution of H_2O, CO_2, Cl, and S in a large body of rhyolitic magma. Annual progress report.** Anderson, A.T. Jr.; Williams, S.N. (Chicago Univ., IL (USA). Dept. of Geophysical Sciences). 1985. Contract AC02-80ER10763. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001220.

The Plinian air-fall unit of the rhyolitic Bishop Tuff is crudely stratified and internally varied. The size and sorting of lumps of pumice increase upwards in several visible air-fall layers. With increasing stratigraphic height pumice is increasingly fibrous (long vesicles) and rich in crystals. Most quartz crystals from fibrous lumps have abundant, large, round but irregular inclusions of glass (quenched melt) free of vapor bubbles and are coated with a relatively thick rind of coarsely vesicular glass. Most quartz crystals from lumps rich in spherical vesicles are coated with a thin veneer of finely vesicular glass and have small, partly faceted (negative crystal) inclusions of glass which commonly are fractured and contain vapor bubbles. Individual lumps of pumice contain a textural range of quartz crystals. Analyses of some melt inclusions incorporating a 400°C bakeout to remove absorbed volatiles suggest that the large irregular inclusions have less than about 0.5 wt % of H_2O. However, more analyses of more thoroughly documented inclusions are needed to be sure. 31 refs., 6 figs., 1 tab.

1494 **(NUREG/CR—1911) SCHEME: the interactive, graphic time history post-processor.** Gerhard, M.A. (Lawrence Livermore National Lab., CA (USA)). Jan 1981. Contract W-7405-ENG-48. 55p. (UCID—18697). NTIS, PC A04/MF A01 - GPO. File Number TI86000912.

SCHEME is a post-processor for time history data. SCHEME will plot time histories, calculate response spectra for specified damping ratios, and perform response spectra statistics. SCHEME allows overplotting and has numerous scaling options. SCHEME is an interactive code that may also be directed to run in a batch type mode. SCHEME also has an extensive error recovery system.

1495 **Elastic-wave velocities in quartz monzonite at different levels of water saturation.** King, M.S. (Lawrence Berkeley Lab., CA). *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts;* **21**: No. 1, 35-38(1984). Contract AC03-76SF00098.

Laboratory ultrasonic velocity measurements were made on quartz monzonite drill core specimens taken from an abandoned iron ore mine in Sweden. Measurements were taken on oven-dried samples and at various moisture levels up to full saturation. The results show that small increases in moisture content can substantially increase V/sub p/ and V/sub S/.

5804 Geochemistry

REFER ALSO TO CITATION(S) 1473

1496 **(DOE/ER/04972—T2) Uranium in clays of crystalline rocks.** Simmons, G.; Caruso, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Earth, Atmospheric and Planetary Sciences). 10 Mar 1985. Contract AC02-78ER04972. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86000878.

Uraniferous clay aggregates in several granites have been examined in detail with a scanning electron microscope (SEM) equipped with a high resolution backscattered electron detector (BSE) and an energy dispersive x-ray system (EDS). The same polished sections used for the microscope observations were irradiated with thermal neutrons and the etched lexan detectors were then used to determine the location of uranium with a spatial resolution of a few microns. A set of 100 samples of the following granites were used for this study: Carnmenellis granite of southwestern England, Conway and Mount Osceola granites of central New Hampshire, Sherman granite of Wyoming and Colorado, Granite Mountains granite of Wyoming, several granites from central Maine, and the Graniteville granite of Missouri. These samples contain clay rich regions as large as a few millimeters that appear to consist entirely of clay when examined with the petrographic microscope. The clays are smectite, nontronite, or vermiculite. The fission track detectors show uranium to be present within the regions. Close examination with the BSE and EDS, however, shows in every instance that the host for the uranium is not clay but clay-sized grains of the following minerals: bastnesite group, hematite, siderite, secondary monazite, secondary thorite, and several different Y-bearing niobates. This finding may have severe implications for the long-term retention of uranium and transuranic elements adsorbed on clay. Perhaps the presence of clay is not significant for the long-term retention of radioisotopes. 22 refs., 7 figs.

1497 **(USGS-OFR—84-575) Analytical results and sample locality map of stream-sediment, heavy-mineral-concentrate, and rock samples from the Little Rockies, Mount Pennell, and Mount Hillers Wilderness Study Areas (UT-050-247,248,249), Garfield County, Utah.** Detra, D.E.; Erickson, M.S.; Kemp, W.M. III; Willson, W.R. (Geological Survey, Reston, VA (USA)). 1984. 63p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900042.

This report presents the results of a geochemical and mineralogical survey of the Little Rockies, Mount Pennell, and Mount Hillers Wilderness Study Areas (UT-050-247,248,249), Garfield County, Utah. The Little Rockies, Mount Pennell, and Mount Hillers Wilderness Study Areas comprise about 350 mi^2 (910 km^2) in Garfield County, Utah. The study areas occupy the southern portion of the Henry Mountains and includes Mount Pennell, Mount Hillers, and Mount Ellsworth. The areas consist of a series of diorite porphyry laccoliths and their satellite bodies, all of Eocene age, which intrude the 8000 ft (2500 m) thick Henry Basin sediments which range in age from Permian to Holocene. Only Triassic and younger rocks are exposed in the areas. Samples were collected at 153 sites. At nearly all of those sites, both a stream-sediment sample and a heavy-mineral-concentrate sample were collected. Where suitable outcrop was available, rock samples were collected. In addition to the spectrographic analysis all heavy-mineral-concentrate samples were mineralogically analyzed. Minerals reported include zircon (round and euhedral), sphene, rutile, anatase, barite, apatite, scheelite, epidote, pyrite, pyroxene, arsenopyrite, amphibole, and rock fragments.

1498 **(USGS-OFR—85-5) Interpretation of geochemical data from panned concentrates of wadi sediments using R-mode factor analysis, Jabal Habashi quadrangle, sheet 26F, Kingdom of Saudi Arabia.** Allen, M.S.; Tidball, R.R.; Samater, R.M.; Selner, G.I. (Geological Survey, Denver, CO (USA); Geological Survey, Reston, VA (USA). Office of International Geology). 1985. 57p. US Geological Survey, Box 25425, Denver, CO 80225. File Number TI86900041.

Panned-concentrate samples from wadi sediments were collected over terranes of Precambrian age intrusive, volcanic, sedimentary, and metamorphic rocks, within the Jabal Habashi quadrangle, sheet 26F, Kingdom of Saudi Arabia. Multivariate analysis of the chemical data indicates that a significant base-metal association occurs in three areas within the quadrangle. An association of strontium, barium, and calcium possibly indicates areas of hydrothermal alteration. Three other associations that were found define the major rock lithologies: niobium-yttrium-lanthanum outlines granitic terranes; magnesium-nickel indicates mafic rocks; and cobalt-vanadium-chromium have an indefinite relation with units mapped as graywacke in the central part of the quadrangle. 6 refs., 35 figs., 2 tabs.

1499 **(USGS-OFR—85-7) Reconnaissance geochemical exploration of plutons of syenite and shonkinite, southern Asir, Kingdom of Saudi Arabia.** Overstreet, W.C.; Assegaff, A.B.; Hussain, M.A.; Naqvi, M.I.; Selner, G.I.; Matzko, J.J. (Geological Survey, Denver, CO (USA); Geological Survey, Reston, VA (USA)). 1985. 70p. US Geological Survey, Box 25425, Lakewood, CO 80225. File Number TI86900040.

Reconnaissance geochemical exploration for rare metals in plutons of syenite and shonkinite disclosed generally less than 20 ppM Nb in rocks, wadi sediments, and concentrates. The sparsity of Nb is accompanied by low values for La, Sn, W, Y, and Zr and relatively high but insignificant values for Be and Mo. Base and precious metals are either below their respective limits of determination in the various sample media or are present at background levels commensurate with average crustal abundances in felsic rocks. Pegmatite dikes associated with the syenite plutons are rare and lack vermiculite. The present investigation disclosed no possible ore deposits in the plutons covered by the field work. Known kyanite-topaz-natroalunite rocks in the vicinity of the surveyed areas should be examined for possible deposits of Cu, Mo, or Au associated with high-alumina hydrothermal deposits. 27 refs., 7 figs., 21 tabs.

1500 **(USGS-OFR—85-8) Reconnaissance geochemical exploration of the plutons of quartz monzonite and granite in the Jabal Lababa and Ar Rayth areas, Southern Asir, Kingdom of Saudi Arabia.** Overstreet, W.C.; Assegaff, A.B.; Jambi, M.; Hussain, M.A.; Selner, G.I.; Matzko, J.J. (Geological Survey, Denver, CO (USA); Geological Survey, Reston, VA (USA). Office of International Geology; Geological Survey, Reston, VA (USA)). 1985. 135p. US Geological Survey, Box 25425, Denver, CO 80225. File Number TI86900035.

Geochemical reconnaissance for rare metals in plutons of albite-muscovite granite and quartz monzonite in the vicinity of Jabal Lababa disclosed positive geochemical anomalies for beryllium, tantalum, thorium, lanthanum, niobium, tin, yttrium, and zirco-

nium. The low anomalous values for the rare metals in rocks and the short mechanical dispersion trains, seldom exceeding 4 km in length, of rare-metal-bearing heavy minerals, are interpreted to indicate that primary deposits of these metals are lacking, and any placers would be small and low in tenor. Small positive anomalies for barium were detected at scattered localities in the metasediments adjacent to the plutons in the Jabal Lababa area. Positive anomalies for the precious metals are lacking, and the low values observed for base metals do not indicate the presence of sulfide deposits. The abundant quartz lag gravel in the eastern part of the area is unmineralized. Small books of muscovite are present in some pegmatite, but is of non-commercial volume and quality. A subcircular structure at the coast of the Red Sea near the month of Wadi Nahb should be tested to determine if it is a buried salt dome. Three nonmagnetic high-density concentrates containing 1000 to 15,000 ppm lead were found on the granitic pluton near Ar Rayth. The source of the lead is not galena, and high values for lead appear to be characteristic of the pluton but do not indicate an ore deposit. 74 refs., 11 figs., 43 tabs.

1501 **(USGS-OFR—85-25) Regional geochemical study of the felsic plutonic rocks in the Nuqrah quadrangle, sheet 25E, Kingdom of Saudi Arabia.** Hall, W.E.; Dellinger, D.; Selner, G.I. (Geological Survey, Menlo Park, CA (USA); Geological Survey, Denver, CO (USA)). 1985. 33p. US Geological Survey, Box 25425, Denver, CO 80225. File Number T186900053.

A regional geochemical investigation of the felsic plutonic rocks of the Nuqrah quadrangle, sheet 25 E, Kingdom of Saudi Arabia, in which pan concentrates of 384 wadi samples, and 145 rock samples, were collected, defined two separate and distinct anomalous areas. One area contains Jabal Tuwalah and Jabal Awja, and the other is at the north end of Jabal Safad. Both pan concentrates and the rock samples in the Jabal Tuwalah and Jabal Awja areas contain high concentrations of Be, F, La, Mo, Nb, Pb, Th, U, Sn, Y, and Zr, and the plutons underlying those areas are characterized by high total-count radioactivity. These elements are sited in highly evolved alkalic granites and have not been concentrated into a potentially metalliferous deposit related to a hydrothermal ore system. They may be a potential metal source of the future. Pan-concentration samples collected from wadis draining the north end of Jabal Safad contain anomalous Sn, Mo, Pb, and La. Four samples contain 250 to 1000 ppM of tin. The tin anomaly is associated with a small aplitic pluton intrusive into the Jabal Safad alkalic granite complex. A brief reconnaissance of the area did not reveal any greisen or cassiterite mineralization. However, further exploration work in the area is recommended. 23 refs., 10 figs., 3 tabs.

5805 Oceanography

1502 **(BNL—36785) Oceanographic data from moored instrumentation. Data report, April 1979.** Hopkins, T.S.; Behrens, W.J.; Swoboda, A.L.; Divis, E.G. (Brookhaven National Lab., Upton, NY (USA)). Apr 1985. Contract AC02-76CH00016. 114p. NTIS MF A01; 2; GPO Dep. File Number DE86001194.

Five instrumented moorings were deployed in the nearshore region off Shinnecock, Long Island, during April 1979. Four of the moorings each had four sensor packages at distributed depths recording velocity, conductivity, temperature and pressure over hourly intervals. The fifth mooring had two fluorometers at two depths. Four moorings were recovered and most sensor packages functioned for the entire period. One mooring disappeared and could not be found after a thorough search. Some of the data returned was of questionable quality due to weather related causes, and several gaps in data transmission occurred during storms. The average period of operation was 21 days. The data are shown here through statistics, real time plots, progressive vector diagrams, and stick figures of 4 hourly averaged currents. This mooring deployment was the observational focus of an oceanographic experiment called Meso-Scale Experiment (MESEX). An objective of MESEX was to observe meso-scale (order 10 km) advective fluxes of temperature, salinity and particulate chlorophyll over the inner shelf off Long Island. The supporting observations included the ADVANCE II cruise, the OCEANUS cruise, an air-sea interaction buoy and a drogue experiment. 21 refs., 5 figs.

1503 **Real-time telemetry system for hydrographic and meteorological data collection in the south Atlantic bight.** Schwing, F.B.; Blanton, J.O.; Lamhut, L.; Knight, L.H.; Baker, C.V. (Skidaway Institute of Oceanography, Savannah, GA). *IEEE Proceedings of the Third Working Symposium on Oceanographic Data System;* 44-50(1983). Contract AS09-80EV10331.

Real-time hydrographic and meteorological data are telemetered from a fixed platform 20 km offshore to a micro-computer system at Skidaway Institute of Oceanography. A suite of sensors tie into the telemetry system. Meteorological parameters sampled include winds, air temperature, and barometric pressure. Ocean currents, water temperature, conductivity, and subsurface pressure are measured below the platform. The telemetry system transmits at a VHF frequency and has the capability to process and transmit voltage values for as many as 32 channels each second. The data stream is automatically sampled on the hour for 150 seconds, and statistics for each parameter are stored on disk and tape. Software is available to perform data editing and reduction and preliminary analysis. The system can be accessed by other agencies, including the National Weather Service.

64 PHYSICS I

6401 Astrophysics And Cosmology

1504 **(BNL—37038) Nuclear equation of state, general relativity and supernovae explosions.** Kahana, S. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-850634—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001193.

From International school for intermediate energy nuclear physics; Veronna, Italy (20 Jun 1985).

Prompt explosions are obtained in hydrodynamic simulations for the 12 Msub solar and 15 Msub solar type II supernova initial models of Weaver and Woosley, when the nuclear equation of state is sufficiently soft and when general relativity is included. 12 refs.

1505 **(DOE/ER/40012—01) Search for magnetic monopoles, neutrino oscillations, and superhigh energy particles. Technical progress report.** Lande, K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Oct 1985. Contract AC02-81ER40012. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001548.

The deep underground Large Area Scintillation Detector and surface air shower array at the Homestake Gold Mine are now in operation. Beginning in January 1985, the underground detector has been searching for muons from Cygnus X-3; the surface-underground telescope has been collecting cosmic ray data since the Spring of 1985. We describe these data, and discuss the experiments to search for magnetic monopoles, neutrinos, and high energy cosmic ray air showers with these instruments and with a new atmospheric Cerenkov detector. There are three elements in the Homestake detector: a deep underground 140-ton Large Area liquid Scintillation Detector (LASD), an extensive air shower array located on the surface above the underground detector, and a Cerenkov telescope to view cosmic ray primary interactions in the upper atmosphere. The combined Large Area Scintillation Detector - Air Shower Array - Cerenkov Detector system is designed to: (1) search for massive magnetic monopoles; (2) measure the flux of high energy neutrinos, search for sources of these neutrinos, and look for neutrino oscillations; (3) measure the composition of very high energy cosmic rays; (4) search for and investigate the nature of the surface and underground flux from Cygnus X-3 and other binary pulsars; and (5) look for neutrino bursts from collapsing stars.

1506 **(LA-UR—85-3314) Halos around ellipticals and the environment dependence of Hubble type.** Zurek, W.H.; Quinn, P.J.; Salmon, J.K. (Los Alamos National Lab., NM (USA); California Inst. of Tech., Pasadena (USA)). 1985. Contract W-7405-ENG-36. 3p. (CONF-8506199—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000755.

From International astronomical union meeting; Princeton, NJ, USA (24 Jun 1985).

It is not surprising that the baryonic material inside the more compact halos will tend to form a more compact, luminous elliptical. What needs to be explained is the difference in the value of the spin parameter (λ). It might be tempting to speculate that more compact, dense halos have systematically smaller values of λ. Such an effect is predicted by linear calculations. Our simulations show that it may exist but it appears to be too small compared to the random scatter of the values of λ and rho to be decisive. It is more likely that the baryonic material has initially similar λ both in the future spirals and elliptical but compact halos damp out the λ of the dissipative, baryonic material more readily.

1507 **(RAL—84-129) Detailed observations of NGC 4151 with IUE. IV. Absorption line spectrum and variability.** Bromage, G.E.; Boksenberg, A.; Clavel, J. (Rutherford Appleton Lab., Chilton (UK)). Dec 1984. 70p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85702743.

Accepted for publication in Mon. Not. R. Astron. Soc. .

A detailed analysis is presented of the ultraviolet (lambda-lambda 1150-3200 A) absorption spectrum of the NGC 4151 Seyfert nucleus. The IUE data base consisted of high dispersion (Δlambda approx. 0.2 A) spectra at 5 epochs, and 137 low dispersion (Δlambda approx. 4-8 A) spectra at 31 epochs from 1978 February to 1980 May, together with further low dispersion data in 1980-81 with NGC 4151 in a very faint quiescent state.

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1508 **(AD-A—155257/9/XAB) Ionospheric electron-density profile and related studies. Final report.** Basu, B.; Decker, D.T.; Retterer, J.M.; Bakshi, P.M. (Boston Coll., Chestnut Hill, MA (USA). Mass Space Data Analysis Lab.). 15 Aug 1984. 74p. NTIS, PC A04/MF A01.

Photoionization of the neutral gas by photons was studied in the extreme ultraviolet (EUV) region of the solar spectrum along with the various particle-particle collisional processes that determine the energy dependence of the photoelectron flux. Also studied were the effects of plasma instabilities in determining the photoelectron energy spectrum in the 2-6 eV energy range. The authors describe a series of case studies, modeling the EDP(Electron Density Profile) using first-principle calculations and comparing the results to a variety of direct measurements. For cases in which simultaneous airglow-emission measurements are available, they evaluate the emissions predicted by the model EDP and compare with the observed emissions. The problem of specifying the flux incident on the atmosphere is addressed with a calculation of the magnetospheric loss-cone population resulting from pitch-angle diffusion. In an effort to describe the phenomena of ion conics, both the means by which turbulence can be caused by precipitating electrons and the way in which the turbulence can accelerate ionospheric ions were studied, using particle plasma simulation techniques. A simplified analysis shows no dependence upon beam current for the spherical geometry and a weak dependence for the cylindrical case.

1509 **(AD-A—155306/4/XAB) Trapping of ion conics by downward parallel electric fields. Technical report.** Gorney, D.J.; Chiu, Y.T.; Croley, D.R. (Aerospace Corp., El Segundo, CA (USA)). 1 May 1985. 29p. (TR—0084A(5940-05)-1). NTIS, PC A03/MF A01.

Several examples of upflowing field-aligned electrons at altitudes between 1000 and 1500 km at high latitudes have been reported recently. The velocity-space distributions of these electrons suggest that they were accelerated out of the ionosphere by downward parallel electric fields, and parallel potential drops of a few tens to a few hundred volts over the altitude range 1000-6000 km are implied. The electron beams are associated with ion conics. Data from electrostatic analyzers onboard the S3-3 satellite show that ion conics can be trapped at low altitude by the downward electric field. Evidence for the parallel electric field is obtained not only from observations of upflowing electron beams but also from observations of retardation of downflowing electrons and local acceleration of downflowing ions. The inferred parallel electric fields have magnitudes large enough to locally balance the magnetic mirror force on perpendicular ion conics in the few hundred eV energy range. This electrostatic trapping has important consequences for wave h ating of ion conics since it extends the residence time of ions in the heating region. It is demonstrated that this multi-pass heating mechanism leads to perpendicular ion heating far in excess of that predicted by present theories of ion conic heating.

1510 **(LA-UR—85-3232) Impulsive ion acceleration in earth's outer magnetosphere.** Baker, D.N.; Belian, R.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 31p. (CONF-8506196—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE86000772.

From Chapman conference ion acceleration; Wellesley, MA, USA (3 Jun 1985).

Considerable observational evidence is found that ions are accelerated to high energies in the outer magnetosphere during geomagnetic disturbances. The acceleration often appears to be quite impulsive causing temporally brief (10's of seconds), very intense bursts of ions in the distant plasma sheet as well as in the near-tail region. These ion bursts extend in energy from 10's of keV to over 1 MeV and are closely associated with substorm expansive phase onsets. Although the very energetic ions are not of dominant importance for magnetotail plasma dynamics, they serve as an important tracer population. Their absolute intensity and brief temporal appearance bespeaks a strong and rapid acceleration process in the near-tail, very probably involving large induced electric fields substantially greater than those associated with cross-tail potential drops. Subsequent to their impulsive acceleration, these ions are injected into the outer trapping regions forming ion "drift echo" events, as well as streaming tailward away from their acceleration site in the near-earth plasma sheet. Most auroral ion acceleration processes occur (or are greatly enhanced) during the time that these global magnetospheric events are occurring in the magnetotail. A qualitative model relating energetic ion populations to near-tail magnetic reconnection at substorm onset followed by global redistribution is quite successful in explaining the primary observational features. Recent measurements of the elemental composition and charge-states have proven valuable for showing the source (solar wind or ionosphere) of the original plasma population from which the ions were accelerated.

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REFER ALSO TO CITATION(S) 1073, 1074, 1076, 1098, 1101, 1910

1511 (ANL—83-100-Pt.1, pp 1-4) **Photoionization of the OH radical.** Dehmer, P.M. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The hydroxyl radical (OH) is one of the most thoroughly studied free radicals because of its importance in atmospheric chemistry, combustion processes, and the interstellar medium. Detailed experimental and theoretical studies have been performed on the ground electronic state (X ^{2}PI/sub i/) and on the four lowest bound excited electronic states (A $^2\Sigma^+$, B $^2\Sigma^+$, D $^2\Sigma^-$, and C$^2\Sigma^+$). However, because it is difficult to distinguish the spectrum of OH from the spectra of the various radical precursors, the absorption spectrum in the wavelength region below 1200 A has not been well characterized. In the present work, the spectrum of OH has been determined in the wavelength region from 750 to 950 A using the technique of photoionization mass spectrometry. This technique allows complete separation of the spectrum of OH from that of the other components of the discharge and permits the unambiguous determination of the spectrum of OH.

1512 (ANL—83-100-Pt.1, pp 5-9) **Photoionization of vibrationally excited N_2.** Dehmer, P.M.; Miller, P.J.; Chupka, W.A. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The high-resolution relative photoionization cross section for N_2 is reported in the wavelength region between the N_2^+ X $^2\Sigma$/sub g/$^+$, v' = 0 and 1 ionization limits. Cross sections from both the X $^1\Sigma$/sub g/$^+$, v" = 0 and 1 vibrational levels were determined in this region, and preionized members of the npπ/sub u/ ^{1}PI/sub u/ Worley-Jenkins Rydberg series converging to $N_2\mu$ X $^2\Sigma$/sub g/$^+$, v' = 1 are observed in both spectra. In the spectrum excited from v" = 1, the Worley-Jenkins series appears prominently as a result of good Franck-Condon overlap between the N_2 X $^1\Sigma$/sub g/^{2}, v" = 1 and the N_2^+ X $^2\Sigma$/sub g/$^+$, v$^+$ = 1 levels; the intensities of the series members decrease approximately as $1/n^3$, in accord with simple theoretical predictions. However, in the spectrum excited from v" = 0, the Worley-Jenkins series converging to N_2^+ X $^2\Sigma$/sub g/$^+$, v$^+$ = 1 is weak as a result of a poor Franck-Condon overlap with the ground vibrational level. The intensities of the series members show large deviations from the simple theory as a result of channel interactions with Rydberg states converging to $N_2\mu$ A ^{2}PI/sub u/. These perturbing Rydberg states have low photoabsorption oscillator strengths for excitation from v" = 1 (in contrast to excitation from v" = 0) and hence have only a small effect on the cross section from the excited vibrational level. The results demonstrate that channel interaction can redistribute the oscillator strength of a perturbing Rydberg state of low principal quantum number over a number of members of an interacting Rydberg series and that the spectral range affected by the perturber can be much greater than the width of the perturbing level.

1513 (ANL—83-100-Pt.1, pp 10-12) **Photoionization of excited molecular states. H_2 C $^1\Sigma$/sub u/.** Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Resonantly enhanced multiphoton ionization (REMPI) affords the researcher the opportunity to select a specific ionization pathway in order to produce a particular ionic state for further study or to investigate detailed aspects of excited state photoionization dynamics. The production of vibrationally state-selected molecular ions using multiphoton ionization techniques can be achieved by first preparing an intermediate Rydberg state that has a potential energy curve similar to that of the final ionic state, and then ionizing the Rydberg state with a single additional photon. Under these circumstances, the Franck-Condon factors governing the final ionization step strongly favor the preservation of the vibrational level of the Rydberg state. Thus, REMPI often may serve as an attractive alternative to more complex coincidence techniques presently used to study the properties and reactions of vibrationally state-selected ions. Here we demonstrate the final vibrational state selectivity of REMPI for the photoionization of the 2pπ/sub u/ C ^{1}PI/sub u/ Rydberg state of H_2, which was prepared by a resonant three-photon transition from the ground electronic state.

1514 (ANL—83-100-Pt.1, pp 15-17) **State selection by resonant multiphoton ionization: N_2^+ A ^{2}PI/sub u/, v$^+$.** Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

In this work we demonstrate the production of electronically excited, vibrationally state-selected molecular ions by resonant multiphoton ionization via a Rydberg state with an electronically excited ion core. Specifically, it is shown that the dominant ionization pathway for three-photon resonant, four-photon ionization of N_2 via the o_3 ^{1}PI/sub u/, v' = 1, 2 levels leads to the production of N_2^+ A ^{2}PI/sub u/, v$^+$ = 1, 2, respectively. The o_3 ^{1}PI/sub u/ state of N_2 has the electron configuration ...$(1\pi$/sub u/$)^3(3\sigma$/sub g/$)^2$ $3s\sigma$/sub g/ and is the lowest member of Worley's third series,[1] which converges to N_2^+ A ^{2}PI/sub 1/2 u/. The ionizing transition strongly favors the removal of the outer $3s\sigma$/sub g/ electron, leading to the direct production of N_2^+ A ^{2}PI/sub u/. This is the first experimental evidence in a molecular system showing the degree to which the electronic excitation of the ion core is retained following photoionization of a Rydberg state.

1515 (ANL—83-100-Pt.1, pp 18-19) **Two-color multiphoton ionization of N_2 and CO.** Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Optical-optical double resonance techniques using fluorescence detection have been used for a number of years as a means of reducing spectral congestion and greatly simplifying spectroscopic analysis. In one version of these two-laser experiments, the first laser frequency is fixed to pump a particular rovibronic transition of interest, while the second laser is used to probe transitions from the upper level of the pump transition to higher excited states. More recently this technique has been coupled with ionization detection, which provides increased sensitivity in many instances and allows the study of levels that do not fluoresce. We have used this technique to study N_2 and CO. In the experiments discussed, the Nd:YAG laser is used to pump a commercial dye laser as well as a homemade dye laser of the modified Littman design described by Mahon and Tomkins. Both dye lasers can be frequency-doubled. The experiments are performed in two parts, with the time-of-flight mass spectrometer used to monitor the ion signal. In the first part, the single-laser, resonant multiphoton ionization spectrum is recorded via the pump transition. Ionization occurs via a two-photon resonant, four photon process. The laser is then tuned to the pump transition of interest and the power is reduced to produce a small background of ionization. At this point the probe laser is made collinear and copropagating with the pump beam by combining them on an appropriate dichroic mirror. In the experiments discussed, the two pulses are overlapped temporally as well. The probe laser wavelength is then scanned and the two-color ionization spectrum is recorded.

1516 (ANL—83-100-Pt.1, pp 20-25) **Photoelectron studies of resonant multiphoton ionization of molecular nitrogen.** Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

In the present paper we present a study of (3 + 1) resonantly enhanced multiphoton ionization (REMPI) of N_2 via the b ^{1}PI/sub u/, v' = 0 - 5, c ^{1}PI/sub u/, v' = 0, 1, and c' $^1\Sigma$/sub u/$^+$, v' = 0, 1 levels. Nominally, the b ^{1}PI/sub u/ state is a valence state, and the c ^{1}PI/sub u/ and c' $^1\Sigma$/sub u/$^+$ states are the 3pπ/sub u/ and 4pσ/sub u/ Rydberg states, respectively, both of which have the N_2^+ X $^2\Sigma$/sub g/$^+$ ion core. However, in this spectral region the c ^{1}PI/sub u/ and b ^{1}PI/sub u/ states are strongly mixed by a homogeneous perturbation, as are the c' $^1\Sigma$/sub u/$^+$ and b' $^1\Sigma$/sub u/μ states (the latter also nominally a valence state). Recently these perturbations have been extensively analyzed at the vibronic level by Stahel et al. This analysis is quite useful in understanding the photoelectron branching ratios from several of these strongly perturbed levels. However, in some instances the situation is complicated further by strong local perturbations and predissociations that affect the rotational structure of these bands, as well as the photoelectron branching ratios, and these cases require going beyond the vibronic approximation.

1517 (ANL—83-100-Pt.1, pp 26-28) **Multiphoton ionization and dissociation of Xe2.** Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

In the present work, we have examined the dissociative states of the g symmetry in the region of the $6s[3/2]_1^o$ level using two-photon resonant, three-photon ionization of Xe_2 formed in a supersonic molecular beam, and monitoring either the photoion or photoelectron signal. Using a time-of-flight mass spectrometer, we recorded the photoion spectrum by monitoring either the Xe^+ or Xe_2^+ ion signal as the wavelength of the frequency-doubled dye laser was scanned. The laser was then tuned to the wavelength of

interest and the photoelectron spectrum was recorded. Photoion spectra were recorded using both a 35-μm jet and an effusive jet.

1518 (ANL—83-100-Pt.1, pp 29-34) **Photoelectron angular distributions from resonant multiphoton ionization of atomic carbon.** Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

In this paper, we report results obtained using resonantly enhanced multiphoton ionization (REMPI) to detect both ^3P and ^1D carbon atoms formed by UV multiphoton dissociation of CCl_4. In addition, we present photoelectron angular distributions for two-photon resonant, three-photon ionization via the 3p $^1S_0$ and 3p $^3D_2$ levels using both linear and circular polarized light.

1519 (ANL—83-100-Pt.1, pp 35) **Angle-resolved photoelectron study of the valence levels of BF_3 in the range 17 < h nu < 28 eV.** Dehmer, J.L.; Parr, A.C.; Southworth, S.H.; Holland, D.M.P. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Photoelectron branching ratios and angular distributions have been measured for the six outermost levels of BF_3 in the range 17 < h nu < 28 eV with the use of synchrotron radiation. Comparisons are made with a recent multiple-scattering model calculation which indicates that a shape resonance in the e′ electronic continuum should appear in five of the six channels studied. Good agreement between experiment and theory is found in a majority of the comparisons; however, experimental evidence for the expected e′ shape resonance is clear in some cases but absent in others. The results are discussed in the context of other cases in which shape resonances, well known from inner-shell spectra, are obscured in valence-shell properties. Experiments that would help clarify the role of the e′ shape resonance in the photoionization dynamics of BF_3 are suggested.

1520 (ANL—83-100-Pt.1, pp 36) **Photoelectron branching ratios and asymmetry parameters for the two outermost molecular orbitals of hydrogen cyanide.** Holland, D.M.P.; Parr, A.C.; Dehmer, J.L. (Daresbury Lab., Warrington, England). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Triply differential photoelectron spectroscopy has been performed on hydrogen cyanide in the photon energy range 14.5 to 24 eV, using synchrotron radiation. Photoelectron branching ratios and asymmetry parameters are presented for the two outermost molecular orbitals. The vibrationally resolved branching ratio X ^2PI ($v_3 = 1$)/($v_3 = 0$) exhibits strong non-Franck-Condon behavior from threshold to approximately 19 eV. The results are discussed in relation to similar studies on the isoelectronic molecules, N_2, CO, and C_2H_2. The evidence suggests that the prominent non-Franck-Condon feature observed in the HCN^+ X ^2PI channel may arise, at least in part, from a shape resonantly enhanced autoionizing state converging to a higher ionization potential.

1521 (ANL—83-100-Pt.1, pp 37) **Photoelectron branching ratios and asymmetry parameters of the two outermost molecular orbitals of methyl cyanide.** Holland, D.M.P.; Parr, A.C.; Dehmer, J.L. (Daresbury Lab., Warrington, England). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Vibrationally resolved photoelectron branching ratios and asymmetry parameters have been determined for the two outermost molecular orbitals of methyl cyanide. The results are discussed briefly within the context of similar studies on cyanogen and hydrogen cyanide, and in relation to structures exhibited in the photoionization efficiency curve.

1522 (ANL—83-100-Pt.1, pp 38) **Fluorescence excitation studies of molecular photoionization in external electric fields.** Poliakoff, E.D.; Dehmer, J.L.; Parr, A.C.; Leroi, G.E. (Boston Univ., MA). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Using molecular nitrogen as an example, we show that fluorescence excitation spectroscopy can be used to measure partial photoionization cross sections of free molecules in external electric fields. The production of the N_2^+ ($B^2\Sigma$/sub u/$^+$) state was studied and the threshold for this process was found to shift linearly with the square root of the applied field. This behavior is compared with the hydrogenic case and with previously studied systems.

1523 (ANL—83-100-Pt.1, pp 39) **Shape resonances in molecular fields.** Dehmer, J.L. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

A shape resonance is a quasibound state in which a particle is temporarily trapped by a potential barrier (i.e., the shape of the potential), through which it may eventually tunnel and escape. This simple mechanism plays a prominent role in a variety of excitation processes in molecules, ranging from vibrational excitation by slow electrons to ionization of deep core levels by x-rays. Moreover, their localized nature makes shape resonances a unifying link between otherwise dissimilar circumstances. One example is the close connection between shape resonances in electron-molecule scattering and in molecular photoionization. Another is the frequent persistence of free-molecular shape resonant behavior upon adsorption on a surface or condensation into a molecular solid. The main focus is a discussion of the basic properties of shape resonances in molecular fields, illustrated by the more transparent examples studied over the last ten years. Other aspects discussed are vibrational effects of shape resonances, connections between shape resonances in different physical settings, and examples of shape resonant behavior in more complex cases, which form current challenges in this field.

1524 (ANL—83-100-Pt.1, pp 40) **Complete dipole oscillator strength distribution and its moments for N_2.** Kosman, W.M.; Wallace, S. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The complete dipole oscillator strength distribution for N_2 has been calculated using the multiple scattering model. From this, the moments of the distribution, $S(\mu)$ and $L(\mu)$, have been computed for $-6 < \mu < 2$. The results are analyzed by decomposing the total moments according to the contributions from various subshells and also according to the contributions from various spectral ranges, e.g., discrete versus ionizing excitations. Since many physical properties depend on these moments, this analysis can pinpoint the spectral ranges with the greatest influence. Special attention is devoted to the distinctly molecular effects on the dipole oscillator strength distribution and its moments, particularly for those channels affected by shape resonances. The Rydberg series, for example, are significantly affected. This analysis offers an explanation for the weakness of certain dipole-allowed Rydberg series and suggests a tentative new assignment for Worley's third series.

1525 (ANL—83-100-Pt.1, pp 41) **Eigenchannel quantum defect theory of open-shell atoms: autoionization resonances and eigenphase shifts of chlorine.** Wang, Z.W.; Lu, K.T. (Jilin Univ., Changchun, China). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Multichannel quantum defect theory is applied to the analysis of Rydberg levels and autoionization resonances of the chlorine atom. The analysis shows that recently observed photoionization cross sections above the $3p^4(^3P)$ threshold of the chlorine ion may be interpreted in terms of unresolved groups of resonances with three different total angular momenta J and approximately the sam e energy. Experimental data of Rydberg levels were used to determine the eigenphase shift (eigen-quantum defect) of electron-ion scattering wave functions. The LS coupling scheme is assumed for the electron + ion compound state. The channel interaction strengths and dipole matrix elements of even parity states relevant to electron-ion collisional and recombination processes are obtained.

1526 (ANL—83-100-Pt.1, pp 42) **Eigenchannel quantum defect theory of open-shell atoms: calculation of $3P^4(^3P)ns$ Rydberg spectra of the chlorine atom.** Wang, Z.W.; Lu, K.T. (Jilin Univ., Changchun, China). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Rydberg spectra of the chlorine atom, $3s^23p^4(^3P)ns$, J = 1/2, 3/2, and 5/2, are calculated by use of an eigenchannel quantum defect method. The results indicate that the channel interactions due to electrostatic and spin-orbit potentials are weak. The effect due to channel interaction of the $3s3p_8$ configuration is completely negligible. Agreement with emission data is excellent (< 0.2% accuracy except for the lowest n = 4 levels). Autoionization resonances are predicted.

1527 (ANL—83-100-Pt.1, pp 53-60) **Electron energy loss spectroscopy of molecular fluorine.** Wang, R.G.; Wang, Z.W.; Dillon, M.A.; Spence, D. (Chengdu Univ. of Science and Technology, Sichuan, China). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Recent renewed interest in the molecular halogens has arisen from their use in rare-gas halide lasers and as laser systems in their own right. This interest has provided motivation for two studies of the electronic structure of fluorine through electron energy-loss spectroscopy (EELS) by Nishimura et al. and by Hitchcock et al. Despite this recent flurry of activity, several questions have remained concerning the electronic spectrum of F_2, principally, the vibrational labelling of electronic states, the effects of impurities on the spectrum, and the identification of laser levels. We have re-examined the spectrum of F_2 using EELS and have been able to resolve most of these questions.

1528 (ANL—83-100-Pt.1, pp 61-66) **Electronic structure of Cl_2 from 5 to 15 eV by electron energy loss spectroscopy.** Spence, D.; Huebner, R.H.; Tanaka, H.; Dillon, M.A.; Wang, R.G. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The electronic structure of molecular chlorine was examined using 200-eV electrons for energy losses between 5 and 15 eV and scattering angles between 3 and 9°. The results dictate a renumbering of the vibration sequence of $4s\sigma\ ^1,^3$ PI/sub g/ states from previous studies.

1529 (ANL—83-100-Pt.1, pp 67-72) **Excitation of Rydberg states of $HgCl_2$ and $HgBr_2$ by electron impact.** Spence, D.; Wang, R.G.; Dillon, M.A. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

We have examined the electronic structure of $HgCl_2$ and $HgBr_2$ from 5 eV to 14 eV by high-resolution electron energy-loss spectroscopy. Our measurements include the near-UV region, which has not been examined by any previous technique and which is found to be rich in Rydbery states. In particular, in each molecule we identify members of two optically allowed Rydberg series and one forbidden series with electronic structures σ/sub g/^{2} σ/sub u/^{2} π/sub u/^{4} π/sub g/^{3} [npπ/sub u/, npσ/sub u/ and ndπ/sub g/, or (n+1)sσ/sub g/] that converge to the ^{2}PI/sub g/ ground ionic state. In addition, other structures that form the dominant energy-loss mechanisms in our spectra are identified as arising from optically allowed Rydberg states associated with the excited ionic states ^{2}PI/sub u/, $^2\Sigma$/sub u/, and $^2\Sigma$/sub g/. Measurements at energy losses below 9 eV confirm previous valence states observed in photoabsorption and suggest the existence of two new valence states in each molecule. Angular measurements facilitate identification of many of the newly observed structures in our electron energy-loss spectra.

1530 (ANL—83-100-Pt.1, pp 73-75) **Observation of a rapid change in the shape of the $6\sigma \rightarrow np\pi$ window resonances in N_2O.** DeMille, D.; Spence, D.; Dillon, M.A. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

In the past few decades, electronic structure in the ionization continuum of N_2O has been investigated by a variety of techniques. Excitation spectra have been reported employing both optical absorption and electron energy-loss methods. In addition, results of photoelectron spectroscopy and photoion-mass spectroscopy have provided information about ionic structure and ion disintegration channels. The first four ionization potentials are 12.89 eV, 16.38 eV, 17.65 eV, and 20.10 eV, which correspond to electron ejection from the 2π, 7σ, 1π, and 6σ orbitals. The range of ~ 4 eV below the fourth ionization threshold is the region of the expected optically allowed autoionizing series ndπ, ndσ, npπ, npσ, nsσ withdrawals 6σ converging to the $C^2\Sigma^+$ ion state. In the course of re-examining this region by electron-impact spectroscopy, we have detected a rapid change with scattering angle in the shape of a series of window resonances. Electron energy-loss (EELS) spectra of N_2O employing incident electrons of 200 eV recorded at scattering angles of 3° and 9° are presented. The 3° electron-impact spectrum closely resembles a spectrum reported in connection with earlier optical work. The observed structure consists mainly of four Rydberg series assigned on the basis of quantum defect arguments. The 9° spectrum exhibits a striking alteration in the neighborhood of the $6\sigma \rightarrow np\pi$ window resonance series.

1531 (ANL—83-100-Pt.1, pp 76-77) **Report of the workshop on electronic and ionic collision cross sections needed in the modeling of radiation interactions with matter.** Inokuti, M. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The workshop was held on 6-8 December 1983 at Argonne National Laboratory. It was attended by more than 40 scientists from outside the Laboratory and by about 10 members of the Laboratory staff. A full record of the Workshop is available as a topical report entitled "Proceedings of the Workshop on Electronic and Ionic Collision Cross Sections Needed in the Modeling of Radiation Interactions with Matter," ANL-84-28, issued in May 1984.

1532 (ANL—83-100-Pt.1, pp 78-95) **What formulas are good for representing dipole and generalized oscillator-strength spectra?.** Inokuti, M; Dillon, M.A. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The dipole oscillator-strength distribution df/d epsilom for a single continuum excitation of an atom or molecule is a function of the kinetic energy epsilom of an outgoing electron. The distribution describes many optical phenomena such as absorption, refraction, and reflection; in particular, df/d epsilom is equal to the cross section for ionization by a photon with energy epsilom + I, apart

from a universal constant, where I is the ionization threshold for the relevant shell. Furthermore, df/d epsilom governs the ionization by glancing collisions of fast charged particles. Recent years have seen considerable accumulation of experimental data on df/d epsilom. Those data are indeed valuable for many applications in radiation physics, plasma physics, atmospheric physics, and astrophysics. In most of these applications, one needs a comprehensive set of data, i.e., numerical values of df/d epsilom over a wide range of epsilom, say, from several eV to many keV. Most often, one needs data at all epsilom at which df/d epsilom is appreciable; however, it is unrealistic to expect measurements to cover all the epsilom values. Consequently, one must find a method for systematizing the data so that one can extrapolate or interpolate them dependably. It is from the above consideration that we started a series of studies aimed at answering the question in the title. The present lecture is a summary of those studies.

1533 (ANL—83-100-Pt.1, pp 96) **Total ionization cross sections for electron impact.** de Heer, F.J.; Inokuti, M. (FOM Institute for Atomic and Molecular Physics, Amsterdam, The Netherlands). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

We conducted an extensive review of experimental techniques for measuring the total ionization cross sections for electron impact, and undertook a critical survey of current data for neutral atoms and molecules. One of our main conclusions is that the current data are far from being complete and reliable and that the time is ripe for renewed efforts toward better measurements.

1534 (ANL—83-100-Pt.1, pp 97) **Electron production in proton collisions: total cross sections.** Rudd, M.E.; Kim, Y.K.; Madison, D.H.; Gallagher, J.W. (Univ. of Nebraska, Lincoln). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Existing data on ionization of neutral atoms and molecules by proton impact are reviewed, and electron production cross-section data are collected. The three major experimental methods are discussed and possible sources of error identified. Some theoretical cross sections are discussed and well-established methods of relating them to other measured cross sections are reviewed. A mathematical equation is fitted to the weighted experimental data for each target, and these fits are adjusted to be consistent with appropriate theoretical calculations and with electron impact and photoionization data. Recommended values of total cross sections for proton-impact ionization are given.

1535 (ANL—83-100-Pt.1, pp 98-99) **How do we decide whether the first Born approximation applies to inelastic collisions of charged particles with an atom or molecule?.** Inokuti, M.; Manson, S.T. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

A motivation of our study is to help resolve a general issue in atomic-collision physics. There are two major sources of uncertainties in the evaluation of cross sections. First, one uses an approximation for treating the collision process, e.g., the FBA, the distorted-wave approximation, or the close-coupling approximation. Second, explicit evaluation of cross sections within any of these approximations must use as input eigenfunctions for the target in the initial state and in the final state at least, and possibly in the intermediate states. It is important to distinguish these two sources of uncertainties as clearly as possible. For instance, once the authors are sure that the FBA holds, the uncertainties in the cross-section evaluation are fully attributable to the uncertainties in the target eigenfunctions. Strong plausibility arguments are given for the validity of the FBA.

1536 (ANL—83-100-Pt.1, pp 100) **Stopping powers of electrons and positrons.** Inokuti, M. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The International Commission on Radiation Units and Measurements (ICRU) several years ago appointed a Committee on Stopping Powers. The charge of this committee is to conduct a survey of experimental and theoretical data for substances of radiological and dosimetric interest and to produce reports on the current status of the topic, including recommended values of stopping powers. An initial report entitled "Stopping Powers for Electrons and Positrons" was issued in October 1984. That report begins with a review of the theory of the collision stopping power. It extensively treats the mean excitation energies for all elements and many compounds, critically analyzes values in the literature, and presents recommended values for many substances. The discussion also includes the density effect, shell corrections, and low-energy phenomena. In addition, plans are laid out for future work. The second phase concerns protons and the alpha particles, and the third phase heavier ions.

1537 (ANL—83-100-Pt.1, pp 101-102) **Inner-shell corrections to the Bethe stopping-power formula evaluated from a realistic atomic model.** Inokuti, M.; Manson, S.T. (Argonne National Lab., IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

Generalized oscillator strengths for K- and L-shell ionization have been calculated using a central potential derived from the Hartree-Slater model. In cases in which an ejected electron carries low kinetic energies, sizable differences with hydrogenic-model calculations are evident.

1538 (ANL—83-100-Pt.1, pp 103) **Theoretical study of excited-state formation due to subexcitation electrons in rare gas - nitrogen mixtures.** Naleway, C.A.; Inokuti, M.; Sauer, M.C. Jr. (American Dental Association, Chicago, IL). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

A model has been developed to theoretically examine the evolution of excited states of N_2 within an inert-gas environment. The helium subexcitation spectrum of electrons as developed by Platzman defines the initial source of excitation energy for the N_2. The further degradation of these low-energy electrons is followed in time down to the threshold for excitation of the N_2(C^{3}PI/sub u/) state. The continuous-slowing-down approximation is invoked, and all loss processes associated with momentum transfer to helium, as well as all accessible inelastic loss processes associated with N_2, are considered. The theoretical rate of formation of C$^3\pi$/sub u/ emission is in qualitative agreement with the experiment and supports the experimentally observed dependence of the rate upon N_2 pressure.

1539 (ANL—83-100-Pt.1, pp 104-105) **Mechanisms for the sputtering of condensed-gas solids by charged particles.** Johnson, R.E.; Inokuti, M. (Univ. of Virginia, Charlottesville). Mar 1985. NTIS, PC A07/MF A01. File Number DE85009364.

In Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.

The relationship of sputtering and luminescence data is examined and some aspects of the electronic relaxation process are discussed. Molecular mechanisms of the relaxation process leading to the dissociation or the production of an atomic or molecular species having appreciable kinetic energy are considered in detail. The role of these mechanisms in charged particle sputtering of insulating materials, especially condensed-gas solids and organic solids, is described.

1540 (BNL—36976) Correlated electron capture and inner-shell excitation measurements in ion-atom collisions. Tanis, J.A.; Bernstein, E.M.; Clark, M.W.; Graham, W.G.; McFarland, R.H.; Morgan, T.J.; Muller, A.; Stockli, M.P.; Berkner, K.H.; Gohil, P. (Brookhaven National Lab., Upton, NY (USA); Western Michigan Univ., Kalamazoo (USA). Dept. of Physics; Ulster Univ., Coleraine (UK). Dept. of Physics; Missouri Univ., Rolla (USA). Dept. of Physics; Wesleyan Univ., Middletown, CT (USA). Dept. of Physics; Giessen Univ. (Germany, F.R.)). 1985. Contract AC02-76CH00016. 7p. (CONF-850701—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000030.

From 14. international conference on the physics of electronic and atomic collisions; Palo Alto, CA, USA (24 Jul 1985).

In an ion-atom collision projectile excitation and charge transfer (electron capture) may occur together in a single encounter. If the excitation and capture are correlated, then the process is called resonant transfer and excitation (RTE); if they are uncorrelated, then the process is termed nonresonant transfer and excitation (NTE). Experimental work to date has shown the existence of RTE and provided strong evidence for NTE. Results presented here provide information on the relative magnitudes of RTE and NTE, the charge state dependence of RTE, the effect of the target momentum distribution on RTE, the magnitude of L-shell RTE compared to K-shell RTE, and the target Z dependences of RTE and NTE. 15 refs., 5 figs.

1541 (BNL-NCS—36952) Atomic weight versus atomic mass controversy. Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-8508138—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001177.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

A problem for the Atomic Weights Commission for the past decade has been the controversial battle over the names "atomic weight" and "atomic mass". The Commission has considered the arguments on both sides over the years and it appears that this meeting will see more of the same discussion taking place. In this paper, I review the situation and offer some alternatives.

1542 (CONF-8509180—1) Charge exchange processes involving iron ions. Phaneuf, R.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001353.

From International Atomic Energy Agency (IAEA) advisory group meeting on atomic data for fusion plasma modelling; Vienna, Austria (18 Sep 1985).

A review and evaluation is given of the experimental data which are available for charge exchange processes involving iron ions and neutral H, H_2 and He. Appropriate scaling laws are presented, and their accuracy estimated for these systems. A bibliography is given of available data sources, as well as of useful data compilations and review articles. A procedure is recommended for providing single approximate formulae to the fusion community to describe total cross sections for electron capture by partially-stripped Fe/sup q+/ ions in collisions with H, H_2 and He, based on the scaling relationships suggested by Janev and Hvelplund.

1543 (DOE/ER/04694—2) Low energy ion-molecule reaction dynamics and chemiionization kinetics. Progress report, February 1, 1985-January 31, 1986. Farrar, J.M. (Rochester Univ., NY (USA). Dept. of Chemistry). 1985. Contract AC02-78ER04694. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001853.

Topics covered include proton transfer reactions, carbon cation reactions, metal ion chemistry, reactive scattering from double minimum potentials, and oxygen-minus reactive scattering. (GHT)

1544 (DOE/ER/10578—3) Hyperfine structure and isotope shift measurements of short-lived elements by laser spectroscopy, January 1-December 31, 1984. Schuessler, H.A. (Texas A and M Univ., College Station (USA). Dept. of Physics). Sep 1983. Contract AS05-80ER10578. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001586.

Research progress is reported in the areas of stored ion spectroscopy, numerical studies of the trapping of pulse injected ions, beam tests at the TRISTAN mass separator, fluorescence line narrowing technique for Doppler-free observation, observation of the isotope shift on long-lived gold isotopes, and observation of Doppler-free signals in a fast Ar^+ beam. (GHT)

1545 (DOE/ER/10578—5) Hyperfine structure and isotope shift measurement of short-lived elements by laser spectroscopy. Progress report. Schuessler, H.A. (Texas A and M Univ., College Station (USA). Dept. of Physics). Oct 1985. Contract AS05-80ER10578. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000346.

The measurement of the hyperfine structure (HFS) splitting and isotope shift (IS) of atomic spectra is continuing to be the major source for the determination of nuclear moments and charge distributions of short-lived nuclei far from stability. In the experiments, ultimate sensitivity of detection must be achieved due to the minute number of short-lived nuclei which can be produced. In addition, the short lifetime requires that the experiments be carried out on-line to the production facility. Presently, mainly neutron-rich isotopes are being studied in our research effort by three sensitive laser techniques, which are collinear fast ion beam laser spectroscopy, stored-ion laser spectroscopy, and Doppler-free polarization spectroscopy.

1546 (DOE/METC—85/4030) Propagation properties of the nonlinear one-dimensional trimolecular reaction. Komkov, V. (USDOE Morgantown Energy Technology Center, WV). Jul 1985. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013610.

A random walk algorithm is presented for computation of nonlinear one- (or more) dimensional trimolecular reaction partial C/partial t = D(x)Del^{2}C + (1 - C)(2 - C)(3 - C).

1547 (GSI—85-13) Positron production in superheavy collisional systems - a sensitive probe for new atomic as well as nuclear physical phenomena. Tsertos, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.)). Apr 1985. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752698.

In the present thesis a systematic study of the integral and spectral properties of the positron production in the collisional systems U+Pd, Pb+Th, U+Th and U+U for incident energies near the Coulomb threshold (5.9 MeV/u) was performed. Additionally for the system U+U the incident energy was varied between 5.7 MeV/u and 6.2 MeV/u with a constant step width of about 0.1 MeV/u. It could uniquely be shown that the positron production in the lighter system U+Pd can be solely explained by the nuclear production process while in the other three collisional systems both the dynamical and the nuclear positron production are experimentally verifiable. The energy-integrated positron production in dependence both on the combined nuclear charge number of the collisional energy and on the impact parameter respectively the incident energy show the expected slope of a scattering process determined by the dynamics of the heavy ion collision which can be well described by the theoretical calculation. From this in the transition from the subcritical system Pb+Th to the supercritical systems U+Th and U+U no significant deviation can be observed, and so no statement about spontaneous positron emission in the supercritical system is possible.

1548 (IFTAR-NP—30-1984) EPR of uranium ions. Ursu, I.; Lupei, V. (Institutul Central de Fizica, Bucharest (Romania)). Feb 1984. 143p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85702720.

A review of the electron paramagnetic resonance data on the uranium ions is given. After a general account of the electronic structure of the uranium free atoms and ions, the influence of the external fields (magnetic field, crystal fields) is discussed. The main information obtained from EPR studies on the uranium ions in crystals are emphasized: identification of the valence and of the ground electronic state, determination of the structure of the centers, crystal field effects, role of the intermediate coupling and of the J-

mixing, role of the covalency, determination of the nuclear spin, maqnetic dipole moment and electric quadrupole moment of the odd isotopes of uranium. These data emphasize the fact that the actinide group has its own identity and this is accutely manifested at the beginning of the 5fsup(n) series encompassed by the uranium ions.

1549 **(INIS-mf—9926) Perturbed-stationary-state theory of inner-shell ionization by heavy charged particles.** Sarkadi, L. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Nov 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86780084.

Submitted to Nucl. Instrum. Methods (NL).

The question of the adiabaticity in the perturbed stationary state (PSS) description of the ion-induced inner-shell ionization of atoms is investigated. A simple method is proposed to include the effect of the nonadiabaticity of the perturbed atomic states which increases with increasing collision velocity. Calculations show that the effect is not negligible, and its inclusion improves the agreement between theory and experiment.

1550 **(INIS-mf—9946) Grandcanonical Monte Carlo simulation of double layer capacity.** Herzog, G.W.; Leitner, H. (Technische Univ., Graz (Austria)). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702723.

Based on hard sphere ions and on a chargable wall the metal/electrolyte interface was simulated by a Grandcanonical Monte Carlo procedure. This method works with ion movements and with single ion additions and subtractions, the latter two leading to higher transition probabilities compared with the usual ion pair approach. Ion-ion and ion-wall interactions cause an enrichment of ions at the interface, which is correlated with an electrical and chemical potential drop with respect to the electrolyte bulk, as was previously claimed by an electrochemical adsorption model for the differential capacity of a double layer. Its dependence on some potential determining parameters was investigated. Moreover, from the calculated electrical and chemical energy for double layer charging it is concluded, that near ZCP this one is a reversible and far from ZCP is an increasingly irreversible process: More and more electrical energy must then be invested into some ordering process at the interface. Although no quantitative agreement with experimental capacity data was found because of the simple ion potentials used, some features of the adsorption model are now better understood.

1551 **(JINR—R-4-84-642) High accuracy energy-level calculations of the rotational-vibrational weakly bound states of ddμ and dtμ mesic molecules.** Vinitskij, S.I.; Gocheva, A.D.; Melezhik, V.S.; Puzynin, I.V.; Puzynina, T.P.; Somov, L.N.; Gusev, V.V.; Ponomarev, L.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702722.

Submtted to the journal Phys. Lett. .

Calculations of the nonrelativistic energies Esub(Jv) of rotational-vibrational weakly bound states J=v=1 of ddμ and dtμ mesic molecules: $E_{11}(dd\mu)$=-1.956 eV and $E_{11}(dt\mu)$=-0.656 eV with an accuracy of 0.001 eV are performed. With the relativistic effects and nuclear finite size correctons taking into account the result is: $E_{11}(dd\mu)$=-1.946 eV and $E_{11}(dt\mu)$=-0.634 eV.

1552 **(JINR—R-14-84-707) About X-ray spectra of oxygen and chlorine in binary compounds.** Yutlandov, I.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702721.

The structure of μX-ray spectra (intensity ratio Ksub(β)/Ksub(α)) of oxygen and chlorine in oxides and chlorides has been considered. Sharp difference in Ksub(β)/Ksub(α) values for oxygen and chlorine as well as difference in character of their dependence on the Z oxidized (chlorinated) element are due to different electron structures of oxygen and chlorine atoms. Vacant 3d-orbits of chlorine (oxygen does not have them) change the character of atomic capture of muons, thus causing corresponding changes in the structure of the α.ray K-series. Attention is paid to anomalous high values of Ksub(β)/Ksub(α) for oxygen in MnO_2 and Fe_2O_3.

1553 **(KIYI—83-22) Stopping power and carbon ion ranges in elements and compounds.** Pucherov, N.N.; Chesnokova, T.D.; Mayatskij, V.D. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702724.

Heavy ion stopping cross section calculations are discussed. The stopping power and C^{12} ion ranges are evaluated using the proton stopping data in matter and Pirson's and Blann's formula for the effective charge. The energy losses due to the elastic collisions with atoms have been taken into account in low energies. The Bregg's rule was used to calculate the stopping power of compounds. The comparison with the available data showed a good agreement. The C^{12} ion ranges with energies from 0.01 to 10 NMeV/nucleon for elements from hydrogen to uranium and several compounds are tabulated. The C^{12} ion energy losses in the layers of definite thickness can be determined using these tables.

1554 **(LA-UR—85-3113) Calibration of a monochromator/spectrometer system for the measurement of photoelectron angular distributions and branching ratios.** Southworth, S.H.; Parr, A.C.; Hardis, J.E.; Dehmer, J.L.; Holland, D.M.P. (Los Alamos National Lab., NM (USA); National Bureau of Standards, Washington, DC (USA). Synchrotron Ultraviolet Radiation Facility; Argonne National Lab., IL (USA); Daresbury Lab. (UK)). 1985. Contract W-7405-ENG-36. 19p. (CONF-850734—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000789.

From 2. international synchrotron radiation instrumentation conference; Stanford, CA, USA (29 Jul 1985).

We describe the techniques used in calibrating a monochromator/spectrometer system for gas-phase photoelectron angular distribution and branching ratio measurements. We report a self-consistent set of values for the Ne 2p, Ar 3p, Kr 4p/sub 3/2/ and 4p/sub 1/2/, and Xe 5p/sub 3/2/ and 5p/sub 1/2/ photoelectron asymmetry parameters and for the Kr 4p/sub 3/2/:4p/sub 1/2/ and Xe 5p/sub 3/2/:5p/sub 1/2/ branching ratios for the energy regions from threshold to approximately 15 iV. 22 refs., 7 figs.

1555 **(LBL—19331) Theoretical study of intermolecular energy transfer of an electronically excited diatomic molecule by atom impact: He(^{1}S) + H_2(B $^1\Sigma^+$ /sub u/).** Grimes, R.M.; Lester, W.A. Jr.; Dupuis, M. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 18p. (CONF-8505193—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001480.

From 12. annual meeting of the National Organization of Black Chemists and Chemical Engineers; Minneapolis, MN, USA (22 May 1985).

An ab initio potential energy surface (pes) for He + H_2(B $^1\Sigma$+/sub u/) has been determined using self-consistent field plus configuration interaction methods. The long-term interactions are described by a multipole expansion. The He-H_2(B $^1\Sigma^+$/sub u/) interaction energy is much more anisotropic than those of ground state systems studied to date. As a first step in the dynamics studies, cross sections for rotational excitation at c.m. energies 0.015-0.105 eV have been computed in the rigid-rotator model using the space-fixed coupled-channel formalism and an analytical fit to the ab initio pes. Partial inelastic cross sections display a high degree of structure, which appears to be mainly due to the anisotropy of the interaction energy. The magnitudes of total cross sections for Δj = +-2 transitions are comparable to those for ion-molecule systems. 13 refs., 5 figs., 3 tabs.

1556 **(LBL—20048) Polyatomic reaction dynamics.** Carrington, T. (Lawrence Berkeley Lab., CA (USA)). Jul 1985. Contract AC03-76SF00098. 118p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86000609.

Thesis.

It is difficult to study the reaction dynamics of polyatomic systems. One of the principal problems is the calculation of the Born-Oppenheimer potential energy surface. In this thesis several useful approximations to the full potential energy surface are proposed and applied. The reaction path approximation to the potential is used to study the vinylidene-acetylene rearrangement. The reaction path approximation is not sufficient when one or more of the

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vibrational degrees of freedom is strongly coupled to the reaction coordinate. In this case it is necessary to expand the potential about a two dimensional surface (the reaction surface) rather than about a one dimensional path (the reaction path). Assuming this form for the potential the reaction surface Hamiltonian is derived. An even better approximation to the full potential energy surface is obtained by expanding the potential about the reaction surface in internal coordinates. A Hamiltonian which allows two internal coordinates to undergo arbitrarily large amplitude displacements is developed and applied to studying malonaldehyde. 57 refs., 5 figs., 1 tab.

1557 **(LBL—20195) Picosecond spectroscopy of chemical reactions in liquids.** Harris, A.L. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 212p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86001209.

To develop a detailed picture of a model bimolecular liquid reaction, picosecond transient absorption measurements from 1000 to 295 nm were used to monitor the dynamics of the geminate iodine recombination reaction in a variety of inert solvents. Most of the atoms which undergo geminate recombination do so in $\leqq$15 ps, in agreement with the predictions of existing molecular dynamics simulations. The subsequent vibrational and electronic energy relaxation of the recombined molecule is relatively slow and accounts for most of the transient absorption dynamics. The relaxing X-state vibrational population distribution is extracted using calculated spectra of the excited vibrational levels. The theory, design and performance of the amplified picosecond dye laser used in the investigations are described. The laser system produces bandwidth-limited 1-ps pulses at a repetition rate of 10 pps with energies of 1 to 2 mJ tunable from 565-610 nm. Short and long term energy stability of +-10% is obtained in a beam with a near-Gaussian spatial profile. 124 refs., 37 figs.

1558 (ORNL—6120, pp 126-154) **Experimental atomic physics.** Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

The experimental atomic physics program within the physics division is carried out by two groups, whose reports are given in this section. Work of the accelerator atomic physics group is centered around the 6.5-MV EN tandem accelerator; consequently, most of its research is concerned with atomic processes occurring to, or initiated by, few MeV/amu heavy ions. Other activities of this group include higher energy experiments at the Holifield Heavy Ion Research Facility (HHIRF), studies of electron and positron channeling radiation, and collaborative experiments at other institutions. The second experimental group concerns itself with lower energy atomic collision physics in support of the Fusion Energy Program. During the past year, the new Electron Cyclotron Resonance Source has been completed and some of the first data from this facility is presented. In addition to these two activities in experimental atomic physics, other chapters of this report describe progress in theoretical atomic physics, experimental plasma diagnostic development, and atomic data center compilation activities.

1559 **(UFRJ-IF—36/83) Nearest neighbors EPR superhyperfine interaction in divalent iridium complexes in alkali halide host lattice.** Pinhal, N.M.; Vugman, N.V. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702728.

Further splitting of chlorine superhyperfine lines on the EPR spectrum of the $[Ir(CN)_4Cl_2]^{4-}$ molecular species in NaCl lattice indicates a super-superhyperfine interaction with the nearest neighbors sodium atoms.

1560 **Improved quasiclassical trajectory method for state to state reactive scattering cross sections and rate constants.** Ashton, C.J.; Muckerman, J.T.; Schubert, F.E. (Brookhaven National Lab., Upton, NY). *Journal of Chemical Physics;* **82**: No. 12, 5788-5798(15 Dec 1984).

A systematic scheme is developed for the incorporation into quasiclassical trajectory (QCT) methodology of recent advances in the understanding of vibrationally adiabatic barriers in collinear atom + diatom reactions. The resulting hybrid QCT method centers on a definite set of rules for optimally combining the results of forward and reverse trajectory calculations. It is argued, and demonstrated by practical examples, that the hybrid method will give a more consistently reliable account of the threshold behavior of collinear reaction cross sections than the conventional QCT method. Extension of the method to the three dimensional F + H_2 reaction gives similarly encouraging results, both for state to state reaction cross sections and for rate constants. 43 references, 15 figures, 4 tables.

1561 **Coordinates for an optimum CS approximation in reactive scattering.** Pack, R.T. (Los Alamos National Lab., NM). *Chemical Physics Letters;* **108**: No. 4, 333-338(13 Jul 1984).

Coordinates for reactive scattering in three dimensions are variationally derived to swing smoothly from reactants to products. These adiabatically adjusting, principal axis, hyperspherical (APH) coordinates are orthogonal, have a simple kinetic energy operator, and allow an optimum centrifugal sudden (CS) approximation; that is, they minimize the coupling neglected by the CSA and also allow optimum l parameters.

1562 **Photoelectron asymmetries and two-electron satellites near the 3p → 3d giant-resonance region in atomic Mn.** Kobrin, P.H.; Becker, U.; Truesdale, C.M.; Lindle, D.W.; Kerkhoff, H.G.; Shirley, D.A. (Univ. of California, Berkeley). *Journal of Electron Spectroscopy and Related Phenomena;* **34**: 129-139(1984). Contract AC03-76SF00098.

The partial cross-sections and photoelectron angular distributions for several lines in atomic Mn have been measured at photon energies between 50 and 72 eV. The intensities of the 3d correlation satellites at 24-26 eV binding energy behave similarly to the main-line intensity near the 3p → 3d giant resonance, but show an enhancement near the 3p threshold which is not present for the main line. A configuration-interaction analysis is applied to help identify the origins of the satellites. The 3p/3d branching ratio from 55-72 eV and the shape of the 3d cross section in the resonance region are in good agreement with many-body perturbation-theory calculations.

1563 **Calculations of the contributions of excitation-autoionization to the electron impact ionization of Ca^+ and Ba^+ in the distorted-wave approximation.** Griffin, D.C.; Pindzola, M.S.; Bottcher, C. (Oak Ridge National Lab., TN). *Journal of Physics B: Atomic and Molecular Physics;* **17**: 3183-3191(1984). Contract W-7405-ENG-26.

The contributions of the excitation-autoionization transitions $3p^64s \rightarrow 3p^53d4s$ in Ca^+ and $5p^66s \rightarrow 5p^55d6s$ in Ba^+ to the total electron impact ionization cross sections of these ions have been calculated in the distorted-wave approximation. Partial cross sections originating from transitions to three of the nine terms in the configuration $3p^53d4s$ of Ca^+ are compared with the recent R-matrix close-coupling calculations for these transitions by Burke et al in order to determine the effect of continuum coupling between autoionizing channels. Both the R-matrix and distorted-wave calculations predict a series of large peaks near threshold in Ca^+ that are not observed in the measurements of Peart and Dolder. Total cross sections with estimates for the contributions of direct ionization are calculated and compared with the ionization measurements of Peart and Dolder for Ca^+ and of Peart et al for Ba^+. Both LS term dependence in the nd radial wavefunctions and unitarization are found to have a pronounced effect on these cross sections. The implications of the discrepancies between theory and experiment are discussed.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 1798

1564 **(UCRL—93396) Electrical conductivity measurements in shock compressed liquid nitrogen.** Hamilton, D.C.; Mitchell, A.C.; Nellis, W.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1985. Contract W-7405-ENG-48. 6p. (CONF-850736—64). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001575.

From American Physical Society topical conference on shock waves in condensed matter; Spokane, WA, USA (22 Jul 1985).

The electrical conductivity of shock compressed liquid nitrogen was measured in the pressure range 20 to 50 GPa using a two-stage light-gas gun. The conductivities covered a range 4 x 10^{-2} to 1 x 10^{3} ohm^{-1} cm^{-1}. The data are discussed in terms of a liquid semiconductor model below the onset of the dissociative phase transition at 30 GPa. 15 refs., 1 fig.

6450 High Energy Physics

1565 **(JINR—1-84) Short notes of JINR. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1984. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780082.

Short note.

Individual notes are separately indexed. (LEW)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 1637

1566 **(BNL—36996) Limits on likesign dilepton production in ν/sub μ/ interactions.** Baker, N.J. (Brookhaven National Lab., Upton, NY (USA)). 22 Aug 1985. Contract AC02-76CH00016. 7p. (CONF-8506194—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001203.

From International symposium on multiparticle dynamics; Kiryat Anavim, Israel (1 Jun 1985).

We have searched for the production of likesign dilepton events (nu/sub μ/ + Ne $\rightarrow$ μ^- + e^- + ...) in a wideband neutrino beam at Fermilab using the 15-ft bubble chamber. We observe no signal above the background arising from conventional sources. We set 90% confidence level upper limits for the production rates of (nu/sub μ/ + Ne $\rightarrow$ μ^- + e^- + ...)/ (nu/sub μ/ + Ne $\rightarrow$ μ^- + ...) < 0.76 x 10^{-4} and (nu/sub μ/ + Ne $\rightarrow$ μ^- + e^- + ...)/ (nu/sub μ/ + Ne $\rightarrow$ μ^- + e^+ + ...) < 5.3 x 10^{-2}.

1567 **(CERN-EP—83-150) Multiparticle production in alpha-alpha and alpha-proton interactions at the CERN intersecting storage rings.** Stenlund, E. (European Organization for Nuclear Research, Geneva (Switzerland)). 3 Oct 1983. 15p. (CONF-830689—12). NTIS (US Sales Only), PC A02/MF A01. File Number DE86900002.

From 14. international symposium on multiparticle dynamics; Lake Tahoe, NV, USA (22 Jun 1983).

Results from a one-week run wth α-particles in the CERN Intersecting Storage Rings, when five different experimental groups took data simultaneously, are presented. The topics discussed are: elastic scattering; quasi-elastic scattering and nuclear break-up; large p/sub T/ physics; multiplicity distributions; fluctuations in the event temperature; Bose-Einstein correlations; and, finally, two-particle correlations. 27 refs., 8 figs.

1568 **(CERN-EP—85-124) First results from the 900 GeV pulsed collider.** Rushbrooke, J.G. (European Organization for Nuclear Research, Geneva (Switzerland)). 7 Aug 1985. 19p. (CONF-8506194—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE86900004.

From International symposium on multiparticle dynamics; Kiryat Anavim, Israel (1 Jun 1985).

The successful operation of the Pulsed Collider at CERN in early 1985 has yielded first physics results from 900 GeV antiproton-proton collisions. A brief description of the pulsed mode of operation is given. The data presented here were obtained with the UA5 detector and relate to the production of charged particles at both 900 and 200 GeV, the multiplicity distributions and their moments, and pseudorapidity distributions, both inclusive and semi-inclusive in multiplicity. A new feature has been the opportunity to measure the ratio of cross-sections at 900 and 200 GeV independently of the machine luminosity. Using the 200 GeV inelastic cross-section obtained by interpolation as input, 900 GeV inelastic non-single diffractive and single diffractive cross sections are derived. Finally a limit on the production of Centauro events is presented. 24 refs., 21 figs.

1569 **(CERN-EP—85-130) Photoproduction of vector mesons.** Paul, E. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; European Organization for Nuclear Research, Geneva (Switzerland)). 13 Aug 1985. 17p. (CONF-850702—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE86900003.

From 11. Europhysics conference on nuclear physics with electromagnetic probes; Paris, France (1 Jul 1985).

From recent high-energy photoproduction experiments we have gained new insights into photon interactions both in the area of spectroscopy of vector mesons and in the area of the interaction dynamics on the nucleon structure level. The interplay between photon structure and nucleon/nuclear structure is analyzed by the measurement of inelastic vector meson photoproduction. 31 refs., 19 figs.

1570 **(DESY—85-018) Observation of three P states in teh radiative decay of Y(2S).** Nernst, R.; Antreasyan, D.; Aschman, D.; Besset, D.; Bienlein, J.K.; Bloom, E.D.; Brock, I.; Cabenda, R.; Cartacci, A.; Cavalli-Sforzea, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1985. Contract AC03-81ER40050;AC02-76ER03066;AC02-76ER03064;AC02-76ER03072;AC03-76SF00515;AM03-76SF00326. 13p. (SLAC-PUB—3571). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752131.

The inclusive photon spectrum in hadronic decays of the Y(2S) is measured with the Crystal Ball detector at DORIS II. Four well separated photon lines, which are consistent with the decay hypothesis Y(2S) -> γ ^{3}Psub(2,1,0) and ^{3}Psub(2,1) -> γ Y(1S), are observed. The energies of the lines from the primary transitions are Esub(γ1) = (110.4 +- 0.8 +- 2.2) MeV, Esub(γ2) = (130.6 +- 0.8 +- 2.4) MeV Esub(γ3) = (163.8 +- 1.6 +- 2.7) MeV; the branching fractions are 5.8 +- 0.7 +- 1.0)%, (6.5 +- 0.7 +- 1.2)% and (3.6 +- 0.8 +- 0.9)% respectively. The secondary transitions center at (Esub(γ)) approx.= 430 MeV with a combined branching fraction of (3.6 +- 0.7 +- 0.5)%.

1571 **(DESY—85-021) Determination of the muon pair branching ratio of the Y' meson.** Albrecht, H.; Binder, U.; Harder, G.; Hasemann, H.; Philipp, A.; Schmidt-Parzefail, W.; Schroeder, H.; Schulz, H.D.; Wurth, R.; Drescher, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752091.

Using the ARGUS detector at the e^+e^- storage ring DORIS-II, we have observed the decays of Y(9460) and Y'(10023) into muon pairs. The ratio of the two observed rates determines Bsub($\mu\mu$) (Y') largely independent of acceptance uncertainties and absolute luminosity calibration, if Bsub($\mu\mu$)(Y) is known. From date with an integrated luminosity of 6.11/pb on the Y and 9.93/pb on the Y', using the present world average Bsub($\mu\mu$)(Y) = (2.9 +- 0.2)%, we obtain Bsub($\mu\mu$)(Y') = (1.57 +- 0.59 +- 0.68)%.

1572 **(DESY—85-029) Study of photon production in hadronic e^+e^- annihilation.** Bartel, W.; Becker, L.; Cords, D.; Felst, R.; Haidt, D.; Junge, H.; Knies, G.; Krehbiel, H.; Laurikainen, P.; Meinke, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1985. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85752134.

The production of photons in e^+e^- -> γ^+ hadrons is investigated at three centre of mass energies around 14, 22 and 34 GeV. On average, photons carry 25% of the total available energy, with a multiplicity similar to the charged multiplicity. The inclusive photon spectra are found to scale with the centre of mass energy as a function of the Feynman variable x. π^0 and eta mesons are reconstructed from their decay photons. The slopes of the spectra are similar to that for charged pions and approximate scaling is observed for π^0 production. The mean π^0 and eta multiplicities are given. The observed photon yield can be fully accounted for by hadron decays and initial state radiation. However, up to one extra photon per event from other sources cannot be excluded.

1573 **(DESY—85-039) Study of energy-energy correlations in e^+e^- annihilations at $\sqrt{s}$ = 34.6 GeV.** Berger, C.; Genzel, H.; Lackas, W.; Pielorz, J.; Raupach, F.; Wagner, W.; Klovning, A.; Lillestoel, E.; Ferrarotto, F.; Gaspero, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1985. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752697.

We present high statistics measurements of the energy-energy correlation (EEC) and its related asymmetry (AEEC) in e^+e^- annihilation at a c.m. energy of 34.6 GeV. We find that the energy dependence as well as the large angle behaviour of the latter are well described by perturbative QCD calculations to O(αsub(s)²). Non-pertubative effects are estimated with the help of fragmentation models in which different jet topologies are separated using ‘epsilon,delta) cuts, and found to be small. The extracted values of ʌsub(MS) lie between 100 and 300 MeV.

1574 **(DOE/ER/10713—4B) Studies of e^+e^- interactions. Progress report, January 1984-December 1984.** Abashian, A. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Aug 1985. Contract AS05-80ER10713. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001656.

Virginia Polytechnic Institute and State University has assumed primary responsibility for the design, construction, and testing of an electromagnetic calorimeter which is the primary device for the detection of electrons and photons in the planned AMY detector at TRISTAN. The design of the calorimeter began together with a program of prototyping of components. Several questions regarding the configuration of the detector are discussed. The development of fabrication techniques for the calorimeter and the design and construction of fabrication fixtures are reported. (LEW)

1575 **(DOE/ER/40152—1) High energy e^+e^- interactions. AIP conference proceedings No. 121.** Panvini, R.S.; Word, G.B. (eds.). (Vanderbilt Univ., Nashville, TN (USA)). 1984. Contract FG05-84ER40152. 445p. (CONF-8404163—). American Institute of Physics, 335 East 45th St., New York, NY 10017. File Number TI85015085.

From 6. international conference on high energy physics; Nashville, TN, USA (6 Apr 1984).

Individual papers in this conference proceedings are separately abstracted. The topics covered include: glueball theory, J/psi decay, photon-photon interactions, signals for supersymmetry in electron-positron collisions, searches for new particles, quark mixing, tau physics, electroweak asymmetry, jets in electron-positron interactions, the strong coupling constant and grand unification, prompt lepton production in electron-positron annihilation, hadron production, 10 GeV physics, b quark spectroscopy. (LEW)

1576 **(IFIN-HE—108-1984) Implementation of GENSEC section from HYDRA 3.40 system on IBM 370/135 (DOS/VS 34.0).** Ponta, T. (Institutul Central de Fizica, Bucharest (Romania)). Jul 1984. 50p. (In Romanian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702760.

In High Energy Physics, processing and interpretation of experimental data, supplied by track-particle detectors, are made by means of the HYDRA system. We present here the implementation on IBM 370/135 (DOS/VS 34.0) (belonging to Central Institute of Physics) of General Section (GENSEC) from the HYDRA system, paying special attention to the description of the 176 routines of this section, in order to facilitate their use on the computer.

1577 **(IFVE-ONF—84-155) Inclusive γ and π^0 production in νA and anti νA interaction.** Baranov, D.S.; Ivanilov, A.A.; Ivanov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 24p. (In Russian). (SERP-E—107). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702761.

Submitted to the journal Sov. J. Nucl. Phys. .

γ-quanta and π^0 mesons inclusive production in neutrino and antineutrino interactions with the freon nuclei in the SCAT bubble chamber is being studied. Multiplicity distributions, dispersion of multiplicity distributions for π^0-mesons and inclusive single particle spectra for γ-quanta and π^0 mesons are considered alongside with the correlations between π^0 and π^- mesons production. γ-quanta and π-mesons production properties in νA-, antiνA-, π^-A interactions are compared. The behaviour of the mean multiplicities and inclusive spectra for γ-quanta and π-mesons are of similar character in νA, anti νA, π^-A interactions. The influence of the harge composition of the reactions and of the secondary rescattering on the nucleus on the correlation between π^0 and π^--mesons production has been observed.

1578 **(LA-UR—85-3199) Muon number violating rare decays.** Cooper, M.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 3p. (CONF-850721—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000775.

From International Europhysics conference on high energy physics; Bari, Italy (18 Jul 1985).

The experimental status of rare decays that violate muon number conservation is summarized, giving upper limits of their branching ratios with 90% confidence. All of the muon experiments share several common elements. They aim to identify the process sought through the measurement of kinematical variables. Large solid angles are required to reach very high sensitivities. The need for good resolution stresses technology in high-rate environments to suppress backgrounds. In order to understand the detector response, known processes are measured where possible. A few experiments planned to detect muon number nonconserving processes are briefly described. 3 refs. (LEW)

1579 **(LBL—19992) Two photon physics with the Mark II at PEP.** Gidal, G. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); Harvard Univ., Cambridge, MA (USA). Dept. of Physics). Jun 1985. Contract AC03-76SF00098. 11p. (CONF-8506194—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000616.

From International symposium on multiparticle dynamics; Kiryat Anavim, Israel (1 Jun 1985).

Measurements of the mass spectrum and angular distribution of high mass meson pairs produced in $\gamma\gamma$ interactions are compared with QCD predictions. The radiative width (Γ(eta' → $\gamma\gamma$) is measured using three different eta' decay modes. Upper limits for the iota radiative width are given.

1580 (ORNL—6120, pp 204-205) **High energy physics.** Cohn, H.O.; Condo, G.T.; Brau, J.E.; Handler, T.; Bugg, W.M. (Univ. of Tennessee, Knoxville). Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

The high energy physics program for this period has centered on a hybrid bubble chamber experiment at SLAC to study charm photoproduction with 20 GeV photons obtained from a backscattered laser beam. The project is a collaboration with groups from SLAC, LBL, MIT, Brown University, Tufts University, University of Tennessee, and other institutions in Great Britain, Japan, and Israel. Over 10% of the photographs obtained were scanned and measured on the spiral reader at ORNL. Charm candidates were selected by careful examination of the vertex of interactions in liquid hydrogen on high resolution photographs taken with special cameras where the lens was diffraction limited with a resolution of about 45 microns. Any event where one or more tracks did not extrapolate to the vertex were considered charm candidates. Geometric reconstruction and momentum determination was

made from pictures taken with a three view conventional optics arrangement.

1581 **Inclusive $\pi 0$ production in 360 GeV pp interactions using the European hybrid spectrometer.** Bailly, J.L.; Bartl, W.; Bruyant, F.; Bugg, W.M.; Caso, C.; Contri, R.; Dibon, H.; Di Marco, R.; Epp, B.; Ferrando, A.; Fontanelli, F. (Universite de l'Etat Faculte des Sciences, Mons, Belgium). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **22**: 119-124(1984). Contract AS05-76ER03956.

The intermediate and forward gamma detectors of EHS are used to reconstruct π^0's produced by 360 GeV/c pp interactions in the Rapid Cycling Bubble Chamber (RCBC). Using the pp forward backward symmetry, the inclusive π^0 production cross section is obtained σ/sub π^0/ = (132 +/- 11) mb. The average π^0 multiplicity is determined as a function of the charged particle multiplicity. The (1-x) dependence is given for different p/sub t/ regions.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 1575

1582 **(BONN-HE—85-15) Monte Carlo study of spontaneous chiral symmetry breaking in lattice gauge theories.** Craigie, N.S.; Mahmood, S.; Katznelson, E. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Mar 1985. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85752700.

Spontaneous chiral symmetry breaking in lattice QCD is studied by calculating special four fermion correlation functions using the Monte Carlo method. In the continuum theory in the limit of short distance and small mass these functions are related to the order parameter. We found a range of quark mass for which the predicted relations approximately hold, using the Susskind formulation of fermions. However, we encountered a theoretical problem in the latter formulation concerning the short distance behaviour of the correlation functions of different spin and flavour. This may cast some doubt on the interpretation of spin and flavour in this formulations.

1583 **(DESY—85-011) Multijet events with missing transverse momentum from squark pair production at the CERN p anti p collider.** Barger, V.; Woodside, J.; Keung, W.Y.; Phillips, R.J.N.; Hagiwara, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Feb 1985. Contract AC02-76ER00881;FG02-84ER40173. 12p. (MAD/PH—230). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752016.

Predictions of the squark pair production scenario, proposed to explain monojets observed at the CERN p anti p collider, are extended to multijets with missing Psub(T). The n-jet cross sections are calculated from lowest-order subprocesses versus squark and gluino masses and compared to new UAI data. Predictions are made for azimuthal correlations ΔPHI, pseudorapidity correlation Δeta, and a jet transverse momentum asymmetry in dijet events and compared with recently observed dijet data.

1584 **(DOE/ER/02220—14) [Basic research in theoretical high energy physics.] Progress report, April 30, 1984-April 30, 1985.** Adler, S.L. (Institute for Advanced Study, Princeton, NJ (USA)). 1985. Contract AC02-76ER02220. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001840.

Progress is reported on non-perturbative problems in quantum field theories, including a field-theoretic issue regarding the relationship between operators on the lattice and in the continuum. The phase diagram of SU(3) lattice gauge theories with light fermions was investigated as a function of the gauge coupling and the fermion mass. A formulation of higher derivative gravity on a simplicial lattice was developed. Analytical and numerical work was carried out in two- and four-dimensional lattice gravity to study the phase diagram of the theory, the existence of nontrivial fixed points, and the question of the renormalization of the cosmological constant. A study was conducted on hadronic decay amplitudes in lattice gauge theory. Other studies conducted include: a covariant functional Schroedinger formalism for quantum field theory in curved space-time, constraints on magnetic mass, anomalies in reparameterization invariance in Type I superstrings, the Wess-Zumino action as an effective description of the anomalies of a theory, quantum fluctuations that can produce small regions of chirally symmetric phase in QCD, and supersymmetry anomalies. Also, the electric charge of a nonabelian magnetic monopole in the presence of fermions was related to a nonabelian generalization of the eta-invariant and computed exactly using Gauss' law. The mathematical connections between chiral anomalies, Levinson's theorem and symmetry breaking have been studied. The physics of fermion number fractionization was reviewed and a general topological theory was developed. The effect of instantons in the field theoretic description of the integral quantum Hall effect was studied. Some aspects of the anomaly cancellation of SO(32) superstring theory after compactification were examined. Also studied were dynamical supersymmetry brreaking and properties of quasi-crystals. 70 refs. (LEW)

1585 **(IFVE-ONF—83-30) Analysis of elastic and quasielastic lepton-nucleon processes in the dual QCD-approach.** Bel'kov, A.A.; Klimenko, L.A.; Kovalenko, S.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702744.

Submitted to the journal Sov. J. Nucl. Phys. .

A semiphenomenological dual approach based on finite-energy sum rules and QCD has been developed for the description of elastic and quasielastic lepton-nucleon scattering. The experimental data on differential cross-sections for neutrino and antineutrino scattering in the range 0.2 $(GeV/c)^2 < Q^2 <= 3.0$ $(GeV/c)^2$ have been analyzed in the framework of a dual approach. The value obtained for the mean quark transverse momentum in nucleon, is psub(T)=(0.45 +- 0.03) GeV. Weak and electromagnetic form factors of nucleon have been calculated. The considered dual approach is shown to be applicable for the description of elastic and quasielastic lepton-nucleon processes at small and moderate transfers 0.2 $(GeV/c)^2 <= Q^2 <$ or approximately 10 $(GeV/c)^2$.

1586 **(IFVE-OTF—84-79) Mechanism of hadron constituent interaction and the total cross section growth.** Troshin, S.M.; Tyurin, N.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702747.

In the framework of a quark model for the U-matrix based on the solution of a simultaneous dynamic equation F=F[U], two different mechanisms of hadron interactions at the level of their structural constituents are considered and, respectively, two alternative possibilities of asymptotic behaviour of the total cross sections. In case of a universal character of the σsub(tot)sup((infinity)) (S) growth the phenomenological data analysis is consistent with the mechanism which leads to the coefficient added in front of $\ln^2 S$ as determined by a mass close to the candidate mass for glueball G(1590) but not by the p-meson mass. The identification of the quark interaction radius with the value iniverse to its mass (geometric mechanism) means a nonuniversal behaviour of the total cross sections at S→infinity while the cross sections dependence on the constituent quark masses allows one to explain the difference in the cross sections magnitude from the viewpoint of different quark composition of hadrons.

1587 **(INIS-mf—9385) Study of the S and P wave scattering in the antiproton-proton system.** Paul, S. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1984. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780085.

The present thesis describes an experiment for the study of the antiproton-proton interaction at low energies. For this purpose at the new Low-Energy Antiproton Ring (LEAR) at CERN, an experiment was performed which allows a simultaneous measurement of the differential elastic and charge-exchange cross section as well as the measurement of the annihilation into charged and neu-

tral pions. After three short but successful beam-times at 600, 300, and 200 MeV/c now first results are present which allow to test existing models in a hitherto not studied momentum range. By means of the elastic scattering, it is possible to determine both the momentum dependence of the total cross sections and the ratio of the real to the imaginary part of the forward scattering amplitude rho. It is shown that the total as well as the annihilation cross sections increases unexpectedly steeply. The momentum behaviour of the parameter rho shows a minimum at approx.= 260 MeV/c and two zero passages at approx.= 500 MeV/c and 230 MeV/c. This behaviour can be explained by none of the existing models and could be interpreted by possible resonances in the anti pp system near the threshold. The results of the measurement of the charge-exchange reaction are compatible with existing measurements at larger momenta (p > 400 MeV/c) and confirm the dominance of the one-pion exchange for small momentum transfer. The question on the existence of a bound state in the anti pp system at 1932 MeV (S meson) remains further open. An observed fluctuation of the excitation function in exactly this mass internal is however in agreement with earlier measurements. (orig.).

1588 (JINR—1-84, pp 7-12) **Cross sections of the inclusive hadron-hadron processes and a possible growth of a number of quark flavours.** Drenska, S.; Mavrodiev, S.Ch.; Sissakyan, A.N. 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780082.

Short note.

In Short notes of JINR. Collection.

1589 (JINR—E-2-84-298) **B, H, H', Q_1 and Q_2 meson decays in the superconductor quark model.** Volkov, M.K.; Osipov, A.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702748.

Submitted to the journal Sov. J. Nucl. Phys. .

A phenomenological meson Lagrangian, based on the effective four-quark interaction, is used to describe two-particle decays of the B(1235), H(1190), H'(1480), Q_1(1280), and Q_2(1400) axial-vector mesons. The widths of all basic decay modes of these mesons are estimated. The value of the Qsub(A)-Qsub(B) mixing angle phi=34 deg is obtained. The deviation of the singlet-octet states mixing angle for H(1190) and H'(1480) mesons from its ideal value equals 12 deg. The radiative decay widths of the B(1235), H(1190), Q_1(1280), and Q_2(1400) mesons are obtained.

1590 (JINR—E-2-84-331) **SU(2)xSU(2) coupling rule and a tensor glueball candidate.** Lanik, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702749.

Submitted to the journal Phys. Lett., B.

The data on the decay of THETA(1640) particles are considered. It is shown that the SU(2)xSU(2) mechanism for coupling of the theta(1640) tensor glueball candidate to pseudoscalar Goldstone mesons is in remarkable agreement with existing experimental data.

1591 (JINR—E-2-84-349) **Soft photoproduction in proton-proton collisions and charged sum rules.** Bilenkaya, S.I.; Christova, E.Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702750.

Submitted to 22. International conference on high energy physics, Leipzig, 1984.

Inclusive production of real soft photons in high-energy proton-proton collisions is considered. The cross section for the process in the leading bremsstrahlung approximation is completely determined by single and two-particle density distributions of all charged particles produced in pp collisions. Charged sum rules of the two-particle densities are obtained. It is shown that the photon bremsstrahlung spectrum may be evaluated only by means of such particle densities which exactly fulfill the charged sum rules. Charged particle densities obeying these requirements have been found. These densities have been used to calculate the real photon bremsstrahlung spectrum at incident proton beam energy 70 GeV and photon scattering angle 8.4 deg. Numerical results show that in analyzing the low energy photon spectrum in high energy proton-proton collisions it is necessary to take into account the contribution of the bremsstrahlung emission from charged particles.

1592 (JINR—R-2-84-122) **Cross sections of inclusive hadron-hadron processes at large Psub(t) and a possible increase of quark type members.** Drenska, S.; Mavrodiev, S.Shch.; Sisakyan, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702752.

Submitted to International seminar Quarks-84, Tbilisi, May 1984 and International seminar on quantum field theory and high energy physics, Protvino, July 1984.

A modified formula was considered for the cross sections of the inclusive E(dσsupiAB→CX)/dsup(3)p (s, psub(T), THETA) obtained in the framework of the anomalous quark counting in the ceating logarithmic approximation of the QCD. The formula describes satisfactorily all experimental data on hadron-hadron interactions in the broad range of energies 40 GeV <= s <= 540 GeV and scattering angles THETA. The analysis indicates a possible increase of a number of quark types (flavours) up to 8-10 at the SPS CERN collider energies ($\sqrt{s}$=54u GeV).

1593 (JINR—R-2-84-557) **Quantum chromodynamics sum rules and J/psi → νsub(c)γ decay.** Bejlin, V.A.; Radyushkin, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702754.

Submitted to the journal Sov. J. Nucl. Phys. .

Within the QCD sum rule approach the radiative decay J/phi → etasub(c)γ is analyzed taking into account both nonperturbative 0(G^2) and perturbative 0(asub(s)) corrections. Under standard assumptions on the magnitUdes of (GG) and asub(s) the width GITA(J/phi → eta sub(c)γ) = 1.7 keV. The experimental value of the width is equal to 0.76sub(-0.22) sup(+0.33). Corrections don't give clear indication on a possibility of obtaining the result near to experimental one.

1594 (JINR—R-2-84-616) **Relations between total hadron-hadron cross sections in two quark models.** Pak, A.S.; Sadykov, N.O.; Tarasov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702755.

Submitted to the journal Sov. J. Nucl. Phys. .

In the framework of the Born approximation of QCD (BA QCD) the total cross sections of meson-nucleon and baryon-nucleon interactions are calculated. It is shown that the results of BA QCD for these values are practically consistent with the same predictions of the additive quark model (AQM). It is also shown that for the discrimination of these two models it is necessary to measure the total cross sections of interaction between nucleons and excited hadronic states σsub(T) (h*N) for which BA QCD and AQM predict rather different values.

1595 (JINR—R-2-84-617) **Factorization relations for hadron diffraction cross sections at the zero angle in two gluon exchange approximation.** Gulamov, K.G.; Pak, A.S.; Sadykov, N.O.; Tarasov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702756.

Submitted to the journal Sov. J. Nucl. Phys. .

Cross sections of the hadron-hadron single and double diffraction reactions are calculated in QCD Born approximation. It is shown that the calculated quantities do not obey the factorization relations of the one-pomeron exchange model.

1596 (JINR—R-2-84-698) **What can be learn from polarization data in the $\pi p p \to \pi^0 n$ reaction.** Kopeliovich, B.Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702757.

Submitted to 2. Seminar on spin effects in high energy physics, Protvino, 1984.

The polarization in the $\pi^- p \to \pi$ deg n reaction is considered in the framework of the standard Regge scheme. The interference of the rho pole with rho f and rho P is taken into account. It is shown that the polarization data can be described only in the case when the "crossover" effect is connected with a change of sign of the non-flip amplitude. The data allow one to jix with a high precision the value of non-flip amplitude slope.

1597 **(JINR—R-2-84-820) Spectra of charmed particles produced in νp interactions.** Bednyakov, V.A.; Bunyatov, S.A.; Isaev, P.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702745.

Momentum spectra and cross sections of D^+, D^-, D^0 charmed mesons and Asub(c)sup(+), epsilonsub(c)sup(++) charmed baryons produced in νp interactions are calculated. Charmed hadrons are produced through recombination of the charmed quark produced in the weak subprocess with quark from the initial proton. The recombination process is described phenomenologically in the language of recombination functions. The probability of fragmentation of initial proton to a set of quarks necessary for production of the charmed hadron with the given quantum numbers is assigned by multiparton distribution functions. These functions have been determined in the framework of statistical parton model with Regge asymptotics which satisfies the QCD main positions. Free paramcters of multiparton distribution functions have been determined from the analysis of data on the production of charmed hadrons in pp-collisions. The calculated spectra of charmed mesons have a "soft" character, the baryonic, on the contrary - a "hard" one. The "hard" spectrum of charmed baryons produced in νp interactions is specified by a "hard" character of Asub(c)sup(+) spectrum produced in pp-collisions.

1598 **(JINR—R-4-85-18) Experiment on discovering a probable spherical asymmetry of electron.** Matora, I.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1985. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702746.

An experiment is proposed based on a property of the charge form factor of elementary particles to provide information as to the mean-square size of the charge distribution only in the direction of the transmitted momentum vector. With its help, characteristic electron sizes both in the direction perpendicular to its spin and inclined to the spin could be measured and compared. The "observed" mean-square radius of the charge distribution of the QED spherical-symmetrical electron caused by a modified Coulomb law for vacuum has been calculated. It turned out to be $(r)=6.8 \times 10^{-13}$ cm. The electron energies needed for measuring the symmetry in the case of the electron-ring model (big radius of the ring $R=3.87 \times 10^{-11}$ cm) are about 50 keV, and for the electron mean radius of QED - in the vicinity of 10 MeV. The measurements are performed on two storage rings with one meeting point nonpolarized but being in the magnetic field electrons.

1599 **(JINR—R-5-84-431) Asymptotic expansion of general solution of Chew-Low equations.** Gerdt, V.P.; Zharkov, A.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702691.

The connection between the global and local expansion of the general solution of the Chew-Low equations is considered. The representations of the Chew-Low equation is used in the form of a system of nonlinear-finite difference equations. The investigation of the properties of the general solution is based on reducing the nonlinear equations to the infinite chain of inhomogeneous linear finite difference equations. It is achieved by global expansion of the general solution in series over powers of one of the arbitrary periodical function c(w), determining the structure of the general integral of the Chew-Low equations. It is shown that in each order in c(w) the asymptotic expansion of the global representation gives the well known local expansion of the general solution. It is confirmed by direct numerical investigation of the asymptotic behaviour of the physically interesting solutions possessing the Born pole.

1600 **(LA-UR—85-3313) Potential energy for quarks.** Heller, L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 17p. (CONF-8508127—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000754.

From Nuclear chromodynamics conference; Santa Barbara, CA, USA (12 Aug 1985).

It is argued on theoretical and phenomenological grounds that confinement of quarks is intrinsically a many-body interaction. The Born-Oppenheimer approximation to the bag model is shown to give rise to a static potential energy that consists of a sum of two-body Coulomb terms and a many-body confining term. Following the success of this potential in heavy Q anti Q systems it is being applied to Q^2 anti Q^2. Preliminary calculations suggest that dimeson bound states with exotic flavor, such as bb anti s anti s, exist. 13 refs., 5 figs.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 1584, 1745

1601 **(DOE/ER/05490—69) Saddle point instability in models of chiral symmetry breaking.** Haymaker, R.W.; Matsuki, T. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). Aug 1985. Contract AS05-77ER05490. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001326.

We examine the stability of models of chiral symmetry breaking based on truncated Schwinger-Dyson equations. We incorporate renormalization group improvement through a running coupling constant. We confirm in a specific model that all chiral symmetry breaking solutions correspond to saddle points of the effective potential functional. The instability can be traced to momentum scales in the range from intermediate to infrared. The region from intermediate to ultraviolet is a completely consistent picture of the energetics of candidate vacuum states. Further systematic patterns of solutions are presented.

1602 **(JINR—E-2-84-572) Mott mechanism and the hadronic to quark matter phase transition.** Blaschke, D.; Reinholz, F.; Roepke, G.; Kremp, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702751.

Submitted to the journal Phys. Lett. B.

A unified description of both the hadronic and quark matter can be found using the technique of thermodynamic Green functions. The destruction of bound states (quark deconfinement) is related microscopically to the Mott mechanism which leads to a different behaviour of free particle energies and bound state energies if the particle density is increasing. A simple model calculation is performed to obtain a rough estimate for the critical temperature of the hadronic-quark matter phase transition.

6454 Field Theory

REFER ALSO TO CITATION(S) 1584, 1600, 1808

1603 **(BONN-HE—85-16) Non-perturbative effects in the perturbation series - the CPsup(N) model.** Davis, A.C.; Nahm, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). May 1985. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752699.

A calculational scheme previously presented to include non-perturbative effects into the perturbation series is extended to the CPsup(N) model. The method yields the non-perturbative mass-gap and determines the dynamics of quanta in the adjoint representation; whereas quanta of the fundamental representation are confined.

1604 (IFVE-OTF—84-59) Two-dimensional supersymmetric nonlinear equations associated with the embeddings of the superalgebra osp(1,2) into the Lie superalgebras. Leznov, A.N.; Savel'ev, M.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702686.

Submitted to the journal Theor. Math. Phys. and Phys. Lett.

A wide class of exactly integrable two-dimensional supersymmetric nonlinear systems is constructed with the Toda lattice as a simplest case. These systems are associated via the Lax-type representation with the local part of an arbitrary Lie superalgebra whose grading is performed by the Cartan element of its superalgebra osp (1, 2).

1605 (IFVE-OTF—84-115) Hidden symmetry of the free fermion model. 2. Partition function. Bazhanov, V.V.; Stroganov, Yu.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702717.

Submitted to the journal Theor. Math. Phys. .

It is shown that the partition function of the free fermion model on a plane lattice has some hidden symmetry properties. Using a specific elliptic parametrization for Boltzmann vertex weights, partition function per site is calculated and shown that it is a meromorphic function of three complex variables.

1606 (IFVE-OTF—84-130) Single-time reduction in quantum field theory. Arkhipov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702707.

Submitted to the journal Theor. Math. Phys. .

It is shown how the causality and spectrality properties in quantum field theory may help one to carry out a single-time reduction of the Bethe-Salpeter wave function. The single-time reduction technique is not based on any concrete model of the quantum field theory. Axiomatic formulations underline the quantum field theory.

1607 (ITEF—25(1984)) Dynamical systems and projective transformations. Petukhov, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702687.

The problem on finding invariance principles under projective Ponincare transformations of dynamical systems in discrete and continious variants, has been solved. The solution for general transformations has been worked out.

1608 (ITEP—61(1984)) About high precision experimental tests of the standard SU(2) x U(1) theory. Bardin, D.; Khovansky, V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702688.

Second-order predictions of the standard Glashow-Salam-Weinberg (GSW) theory are discussed. The capabilities of the near future experiments to test them are estimated. It is shown that foreseen experiments could give a sign of existence of fermions heavier than W and Z bosons and could test the GSW theory beyond the Born approximation.

1609 (ITEP—71(1984)) Wilson's operator expansion: can it fail. Novikov, V.A.; Shifman, M.A.; Vainshtein, A.I.; Zakharov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85702689.

The status of operator product expansion (OPE) in the presence of nonperturbative effects is discussed within the framework of some simple 4d Higgs model, 2d sigma-model and Schwinger model. The general formulation of OPE is presented and it is demonstrated that there exists a consistent procedure allowing one to define unambiguously both coefficient functions and matrix elements of composite operators. One of the key elements of the procedure is introduction of an auxiliary parameter, the normalization point μ. The two extremes considered are lambda phi^4 theory with no spontaneous breaking of the symmetry and the O(N) sigma model in the limit N→infinity. In the former case there is only perturbative contribution to (phi^2) while in the latter case the perturbative pieces are suppressed by 1/N factors. Numerically QCD is much closer to the O(N) sigma model in the large N limit. Comments on specific features of QCD are presented.

1610 (ITEP—119(1984)) Summation of perturbation series for screened Coulomb potentials. Popov, V.S.; Weinberg, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85702696.

Higher orders of perturbation theory (PT) in quantum mechanics and field theory rise factorially at k→ infinity (k is the PT order). The computation results are discussed of higher orders of PT and summation methods for divergent perturbation series (PS) for quantum mechanical problems: the Yukawa and Hulthen potentials, funnel-shaped potential etc. Criteria of PS summability by the Pade approximations are examined.

1611 (JINR—E-2-84-126) Radiative corrections to photon states between plates. Bordag, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702699.

Submitted to the journal Sov. J. Nucl. Phys. .

Radiative corrections to the photon states are considered in the presence of boundary conditions given by two superconducting parallel plates. The developed earlier canonical quantization method for covariant gauge electrodynamics in the presence of boundary conditions is used and it turns out to be convenient for handling this problem. For the photon states between the plates one observes a shift of the photon energy due to radiative corrections which can be interpreted as a renormalization of the distance between the plates seen by the photon. The photon wave functions are found to be spread in the momentum space, also due to radiative corrections.

1612 (JINR—E-2-84-650) Spontaneous topological vacuum degeneration in non-Abelian theory. Azimov, R.I.; Pervushin, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702708.

Submitted to the journal JETP Lett. .

It is shown that the transversal non-Abelian fields in a finite-volume space can topologically be degenerated in the lowest order of perturbation theory. Physical consequences of such a degeneration are discussed.

1613 (JINR—E-2-84-720) Harmonic superspaces of extended supersymmetry. The calculus of harmonic variables. Ivanov, E.; Kalitzin, S.; Nguyen Ai Viet; Ogievetsky, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702718.

Submitted to the journal J. Phys. A: Math. and Gen. .

The main technical apparatus of the harmonic superspace approach to extended SUSY, the calculus of harmonic variables on homogeneous spaces of the SUSY automorphism groups, is presented in detail for N=2, 3, 4. The basic harmonics for the coset manifolds G/H with G=SU(2), H=U(1); G=SU(3), H=SU(2)xU(1) and H=U(1)xU(1); G=SU(4), H=SU(3)xU(1), H=SU(2)xSU(2)xU(1), H=SU(2)xU(1)xU(1) and H=U(1)xU(1)xU(1); G=USp(2), H=SU(2)xSU(2), H=SU(2)xU(1) and H=U(1)xU(1) are tabulated a number of useful relations among them.

1614 (JINR—E-2-84-777) Some integrals for exact calculation of QED bremsstrahlung. Akhundov, A.A.; Bardin, D.Yu.; Riemann, T.; Fedorenko, O.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702709.

An exhaustive list of integrals is presented which has been used together with the system of analytical calculations SCHOONSCHIP to obtain exact results from the energetic fermion spectrum and the total cross section of the $e^+e^- \to f^+f^-(\gamma)(f=\mu$, tau, ...) process to order α^3 in QED. These integrals are calculated without neglections in the particle masses. They are of general interest for exact calculations of bremsstrahlung processes in QED and in analogue processes of quantum chromodynamics.

1615 (JINR—E-2-84-783) Absorptive part of the VVA triangle graph: a collection of formulae. Horejsi, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702710.

A set of formulae is presented for the absorptive part the familiar triangle graph with two vector and one axial vertex. Properties of the pseudotensor basis used for definition of the corresponding invariant amplitudes and the ambiguity of such a definition are discussed in detail. There are essentially two independent invariant amplitudes presented explicitly. The results of previous treatments dealing with the subject are extended and generalized. The limiting cases of vanishing fermion mass and or some of the external momenta being light-like are briefly discussed. The recovery of axial anomaly via dispersion relations is also considered.

1616 (JINR—E-2-85-56) Dispersive derivation of triangle anomaly. Horejsi, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702711.

A straightforward generalization of the results of some previous treatments, in which the Adler-Bell-Jachiw triangle anomaly has been recovered with the help of dispersion relation is presented. The absorptive part of the VVA triangle diagram with the external momenta k, p at vector vertices such as $K^2=p^2<=0$ and the fermion mass $m>=0$ is considered. An integral of the imaginary part of the relevant invariant amplitude is calculated explicitly. It is shown that the anomalous contribution to the axial Ward identity is reproduced. This also enables one to demonstrate the delta-like behaviour of sich an imaginary part in $k^2 \to 0$, $m \to 0$ limit.

1617 (JINR—R-2-84-176) Dynamical generation of interaction in an exactly solvable model. Avdeev, L.V.; Chizhov, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702712.

Submitted to the journal Phys. Lett., B.

The dynamical generation of interaction in the chiral-invariant Gross-Neveu model leads to an asymptotically free charge behaviour and a correlation between coupling constants. The known exact solution possesses similar properties.

1618 (JINR—R-2-84-329) Evolution kernel for the pion wave function in the scalar phisub((6))sup(3) model: two-loop calculation. Mikhajlov, S.V.; Radyushkin, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702753.

Submitted to the journal Nuovo Cimento A.

The structure of the evolution kernels for the pion wave function is studied in the two-loop approximation of the phasub((6))sup(3) model. In the case corresponding to absence of the charge renormalization at the one-loop level an explicit form of multiplicatively renormalized operators is obtained. It is shown that the latter do not coincide with the conformal tensors, although having a similar structure.

1619 (JINR—R-2-84-471) To the problem of unification of all interactions. Pestov, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702758.

Submitted to the 13. International conference on differential-geometrical methods in theoretical physics, Sumen, Bulgaria.

Group-theoretical properties of general relativity are proposed to be used as a possible method for solving the probiem of unification of all interactions. The symmetry of general relativity provides rigid constraints and uniquely determines the wave tunction. The wave equation is established with the use of metrics and torsion. Tne connection is found for the group of internal symmetry of tne wave equation with the currvature, torsion, and the general property of absolute parallelism.

1620 (JINR—R-2-84-683) Investigation of infrared singularities in corrections for soliton mass. Zlatev, S.I.; Matveev, V.A.; Chechelashvili, G.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702713.

On the base of the simplest model, for which the equation of motion possesses particle-like classical solutions, the problem of infrared singularities is discussed in the framework of one of the quantization approaches to these solutions. By means of an asymptotic expansion of the diagrams on the inverse powers of total time, the cancellation of infrared divergencies in the expression for the third (three-loop) quantim correction to the solution mass is shown. The additional vertex, appearing in the process of extracting the space translation groue volume turns out to be essential for the cancellation of divergencies and gives a contribution to the soliton mass correction.

1621 (JINR—R-2-84-699) Pauli principle and hidden symmetries. Beshtoev, Kh.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702719.

The consequences of hypothesis as to the existence of Gsub(n)=Usub(n), SUsub(n), Osub(n), SOsub(n) ($n>=2$) symmetry groups for particles with semi-integer spins, that obey the Fermi-Dirac statistics are considered. Possible realizations of Gsub(n) group in the four-dimensional space are the following: a) completely broken symmetry of Gsub(n) group; b) the unbroken symmetry of Gsub(n) group. Then this group should be hidden, and in a free state there can exist only scalar constructions of Gsub(n).

1622 (JINR—R-2-84-716) Infrared asymptotics and confinement. Efimov, G.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702759.

Submitted to the journal Annal. Phys. .

It is shown that the infrared behaviour of the gluon propagator D tilde $(k)=-1/(k^2)^2$ leads to the quark confinement. The arguments are formulated why this infrared singularity is not satisfactory. The hypothesis that the gluon propagator on large distances in the Euclidean space behaves as $D(x)$ approximately $A+B(1/x^2) + O(1/(x^2)^2)$ where A and B are constants leads to the quark confinement and to the production of stable bound states.

1623 (JINR—R-2-84-753) Quantum field theory and Markov maximon. Kadyshevskij, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 50p. (In Russian). (CONF-8410305—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702714.

From 3. international seminar on quantum gravitational theory; Moscow, USSR (23 Oct 1984).

A new concept of the field equivalent to the Markov principle is introduced, and the relevant generalisations of the Klein-Gordon, Dirac and Maxwell equations are set up. The gauge invariant quantum electrodynamics constructed along these lines predicts a number of new nonminimal electromagnetic interactions including

four-fermion interactions with the coupling constants approximately e^2/M^2. Charged Dirac particles are obliged to have inherent anomalous magnetic and electric dipole moments (MDM and EDM), the presence of EDM testifying to P- and CP-symmetry violation. The most intriguing prediction of the new QED implies that a new family of charged fermions with giant MDM and EDM nonvanishing even in the limit M → infinity must exist in nature.

1624 **(JINR—R-2-84-836) Fermion propagator calculation in some two-dimensional lattice models of quantum electrodynamics.** Bogolyubskaya, A.A.; Bogolyubskij, I.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702715.

Two variants of the conjugate gradient method (CGM) are used for computer calculations of fermion propagators in various formulations of two-dimensional lattice gauge theory including fermions. Propagators of Wilson fermions, "naive" fermions, Jacobs formions and Kogut-Suskinnd fermions are computed on various size NxN lattices. Numerical calculations indicate that Jacobs formulation does not solve the "doubling problem". The number of iterations Nsub(conv) needed for calculation of the fermion propagator by means of CGM with delta $< 10^{-3}$ relative accuracy increases with the size of lattice slower than N; Nsub(conv) grows with decreasing of the fermion mass.

1625 **(JINR—R-2-85-10) Anomalies and supersymmetry.** Kazakov, D.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702716.

Report on 21. session of JINR scientific council on theoretical physics.

The problem of quantum anomalies in supersymmetric gauge theories is reviewed. They are the anomaly of supersymmetry, the axial anomaly and the anomaly of supercurrent. The consequences of quantum anomaly are analysed for the axial anomaly in QED. It is emphasized that supersymmetry itself is not anomalous. The supercurrent anomalies do not contradict that of the axial current and form a supermultiplet of anomalies. Anomalies do not destroy the supersymmetry.

1626 **(JINR—R-4-84-727) Theory of spin 1/2 particle motion on a three-dimensional sphere in Euclidean four-dimensional space.** Yamaleev, R.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702690.

The equation of motion for particles with spin 1/2 on an S^3 sphere has been formulated based on the intimate connection of the SU(2) group with the group of motion on a three-dimensional sphere. It is shown that this connection becomes obvious if spin operators and their infinite-dimensional analogues are defined in the representation of Cartesian basis. A system of operator ratios in 4-dimensional Euclidean space for defining the Hamiltonian operator for particles with spin 1/2 is obtained, and an interpretation of the fourth coordinate is given. The theory becomes canonical, when passing to sphere S^3, where the Hamiltonian operator is expressed exceptionally in terms of the SU(2)xSU(2)/+-1 group realizing finite- and infinite-dimensional representations. Transformational properties of the equation with regard to coordinate transformations, and the problem of gauge invariant method of introducing the external electromagnetic field are investigated. It is shown that the theory leads to the conception of spin energy and unbound state energy quantization.

1627 **(JINR—R-5-84-719) sigma - model representation of the Yajima-Oikawa equation system.** Makhan'kov, V.G.; Myrzakulov, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702692.

The Yajima-Oikawa equation system describing the Langmuir turbulence in plasma in the low temperature region and in the ultrarelativistic limit and magnon-phonon interaction in magnetic chains is investigated. Gauge equivalent equations to the Yajima-Oikawa equations and to the equation of resonance interaction of short and long waves are searched for. The gauge transformations are given in a standard way: U tilde = gsup(-1)Usub(g) + g^{-1}gx, V tilde =gsup(-1)Vsub(g) + g^{-1} qt. Gauge equivalent equations to the Yajima-Oikawa equation system have been found by the gauge transformation. It is shown that the equations of resonance interaction of short and long waves are gauge invariant to a certain generalization of Landau-Lifshits equations. That means that the Yajima-Oikawa equation system and equations of resonance interaction of short and long waves contain more information as compared with the classical Landau-Lifshits equation.

1628 **D=11 supergravity: a class of solutions with a vanishing cosmological constant.** Wu, X. (Massachusetts Institute of Technology, Cambridge). *Physics Letters [Section] B;* **144B**: No. 1-2, 51-54(23 Aug 1984). Contract AC02-76ER03069.

A class of solutions of D=11 supergravity is explicitly constructed, in which the extra dimensions are spontaneously compactified to a squashed and parallelized S^7 and therefore the cosmological constant in four dimensions vanishes. The existence of eight constant Killing spinors in these solutions suggests that there are 8 supersymmetries in four dimensions. As a by-product, an explicit formula for the Cartan-Schouten-Englert parallelizing torsion is obtained, which is globally valid on S^7.

65 PHYSICS II

6510 Nuclear Physics

1629 **(BNL-NCS—36975) Nuclear data and related services.** Tuli, J.K. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-850942—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE85017843.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

National Nuclear Data Center (NNDC) maintains a number of data bases containing bibliographic information and evaluated as well as experimental nuclear properties. An evaluated computer file maintained by the NNDC, called the Evaluated Nuclear Structure Data File (ENSDF), contains nuclear structure information for all known nuclides. The ENSDF is the source for the journal "Nuclear Data Sheets" which is produced and edited by NNDC. The Evaluated Nuclear Data File (ENDF), on the other hand is designed for storage and retrieval of such evaluated nuclear data as are used in neutronic, photonic, and decay heat calculations in a large variety of applications. Some of the publications from these data bases are the Nuclear Wallet Cards, Radioactivity Handbook, and books on neutron cross sections and resonance parameters. In addition, the NNDC maintains three bibliographic files: NSR - for nuclear structure and decay data related references, CINDA - a bibliographic file for neutron induced reactions, and CPBIB - for charged particle reactions. Selected retrievals from evaluated data and bibliographic files are possible on-line or on request from NNDC. 6 refs., 1 fig.

1630 **(INIS-mf—9383) Acceleration Laboratory of the University and the Technical University of Munich: Annual report 1984.** (Beschleunigerlaboratorium der Univ. und Technischen Univ. Muenchen, Garching (Germany, F.R.)). 1984. 191p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE86780087.

This annual report contains extended abstracts about the work performed at the named institute together with a list of publications and reports. The work concerns heavy ion reactions, reactions with light and polarized particles, nuclear spectroscopy, atomic physics, accelerator mass spectroscopy, the theory of nuclear reactions and nuclear structure, and developments of accelerators, radiation detectors, and data processing.

1631 (INIS-mf—9759) 5. Nordic meeting on nuclear physics. Proceedings. (Jyvaeskylae Univ. (Finland). Dept. of Physics). 1984. 454p. (CONF-8403127—). NTIS (US Sales Only), PC A20/MF A01. File Number DE85781595.

From 5. Nordic meeting on nuclear physics; Jyvaskyla, Finland (12 Mar 1984).

Abstracts of individual items from the meeting were prepared separately for the data base. (GHT)

1632 (INIS-mf—9901) Some highlights of the Daresbury nuclear structure programme. Gelletly, W. (Manchester Univ. (UK). Schuster Lab.). 1984. 122p. (CONF-8408148—3). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780042.

From International school of atomic and nuclear heavy ion interactions; Poiana Brasov, Romania (28 Aug 1984).

The paper concerns the nuclear structure programme at the Daresbury laboratory, United Kingdom. A description is given of the Nuclear Structure Facility (NSF), along with its principal properties and design features. Some of the latest equipment used at the NSF is discussed, including the isotope separator, recoil separator, magnetic spectrometer and gamma-ray detectors. Uses of this equipment at the NSF to study the nuclear properties at high angular momentum and nuclei far from stability, are also described. (U.K.).

1633 (LA-UR—85-3234) Potential capabilities at LAMPF to study nuclei far from stability. Talbert, W.L.; Bunker, M.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850942—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000770.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Feasibility studies have shown that a He-jet activity transport line, with a target chamber placed in the LAMPF main beam line, will provide access to short-lived isotopes of a number of elements that cannot be extracted efficiently for study at any other type of on-line facility. The He-jet technique requires targets thin enough to allow a large fraction of the reaction products to recoil out of the target foils; hence, a very intense incident beam current, such as that uniquely available at LAMPF, is needed to produce yields of individual radioisotopes sufficient for detailed nuclear studies. We present the results of feasibility experiments on He-jet transport efficiency and timing. We also present estimates on availability of nuclei far from stability from both fission and spallation processes. Areas of interest for study of nuclear properties far from stability will be outlined. 17 refs.

1634 (NEANDC(J)—106-U) Progress report (July 1983 to June 1984 inclusive). [Nuclear data]. Kikuchi, S. (ed.). (Nuclear Energy Agency, 75 - Paris (France). Nuclear Data Committee). Sep 1984. 81p. (INDC(JPN)—92-U). NTIS (US Sales Only), PC A05/MF A01. File Number DE86900184.

This is a collection of reports which have been submitted to the Japanese Data Committee at the Committee's request. The request was addressed to the following individuals who might represent or be in touch with groups doing researches related to the nuclear data of interest to the development of the nuclear energy program.

6511 Experimental Techniques

1635 (LBL—20163) Unresolved gamma rays from high-spin states. Stephens, F.S. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 17p. (CONF-850672—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001401.

From 2. international conference on nucleus-nucleus collisions; Visby, Sweden (10 Jun 1985).

The γ-rays which are emitted from the highest spin states in nuclei cannot be resolved using present techniques. Nevertheless, methods are being developed to study nuclear structures in this spin range. For example, coincidence data has been used in the study of superdeformations and moments of inertia. While the general properties of these correlation plots are in accord with present expectations, there are several puzzling features of the data which require more study. One unresolved aspect concerns γ-ray energy spreads in a given decay pathway. In addition, higher-order correlation methods are in various stages of inception. 15 refs., 16 figs. (WRF)

1636 The evolution of LAMPF and its research programs. Rosen, L. (LAMPF, Los Alamos National Lab., Los Alamos, NM). *Arabian Journal for Science and Engineering;* 8; No. 4, 267-299(Oct 1983).

The multiple beam lines and the variety of particle beams at the Clinton P. Anderson Meson Physics Facility (LAMPF) permit a wide range of experiments in particle and nuclear physics and nuclear chemistry. Some of the principal achievements at LAMPF during the past few years are described.

6512 Nuclear Properties And Reactions, A=1-5, Theoretical

1637 (DOE/ER/03244—117) Experimental Medium Energy Physics annual progress report, June 1984-May 1985. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1985. Contract AC02-76ER03244. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86001839.

During the past year the principal activities of the CMU Medium Energy Physics Group have included the running of three previously approved experiments, the development of hardware and software for these experiments, and final analysis of previously accumulated data. In a two week run at LEAR at the beginning of this year 100 data tapes were collected on experiment PS-185. This spring sigma hyperon production in Lithium was studied in a run on AGS experiment E-774. We are currently setting up AGS experiment E-788 in an investigation of Lambda weak decay in Helium hypernuclei. In addition a new experiment to search for strangeness S = -2 dibaryon production was presented and approved by the AGS program advisory committee for 1000 h (E-813). For these experiments extensive hardware and software development has taken place, requiring much of the group's effort. Analysis of LEAR experiment PS-185 is in full progress at CMU. Both the weak decay studies of ^{12}C (AGS E-759) and the pion annihilation studies in Lithium and Oxygen have now been fully analyzed with the results submitted for publication in several papers. All of these activities are described. Specific hardware and software projects are discussed.

1638 (DOE/ER/10332—15) Investigations of the structure and electromagnetic interaction of few-body systems. Lehman, D.R. (George Washington Univ., Washington, DC (USA). Office of Sponsored Research). 1985. Contract AS05-79ER10332. 35p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001659.

Progress is reported in these areas: γ^3He → pd in the 200 to 400 MeV region; application of the Austern model to the reactions γ^3He → pd, π^{03}He → pd; analyzing power in pd → γ^3He at intermediate energies; elastic and inelastic electron scattering from ^{6}Li; quasielastic electron and proton scattering from ^{6}Li; higher shell orbitals in ^{6}Li in jj and LS coupling and the magnetic moment of ^{6}Li from three-body models; explanation of the binding energy difference between the ground and first excited state of the A = 4 Λ-hypernuclei; the asymptotic normalization constants for ^{4}He→n+^{3}He and ^{4}He→d + d; low-energy two body photodisintegration of ^{3}He and ^{3}H; photodisintegration of the deuteron; and photodisintegration of the trinculeon at intermediate energies. (LEW)

1639 (INIS-mf—9345) Angular distribution of the neutron-proton final-state interaction in the reaction d(α,αp)n at 28,2 MeV incident energy. Heinrich, C. (Hamburg Univ. (Germany, F.R.). Fachbereich Physik). 30 Jan 1984. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780014.

The reaction d(α,p α)n was investigated in kinematically complete experiments in coplanar and noncoplanar geometry. The angular distribution for the production of n-p pairs with zero rela-

tive energy was measured at the bombarding energy Esub(α)=28.2 MeV. The experimental results have been compared with Faddeev calculations by Y.Koike and K.Hahn and in the region of np final state interaction (FSI) with the improved sequential decay model by K.Wick. At large production angles of the n-p pair the absolute cross sections are fairly well predicted by the sequential decay model, at smaller angles, however, the simple assumptions of the model result in major differences. The agreement of the data with the Faddeev calculations of Koike is generally good, especially the shape and position of the dominating FSI-structures is well reproduced. This is surprising because of the simple potentials, which are used. Some deviations occur in the intensity of the different effects. (orig.).

1640 **(ISN—84-42) Experiments with polarized deuteron beams at Saturne.** Arvieux, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1984. 4p. (CONF-8409162—16). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752921.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

The Saturne synchrotron can accelerate up to 2.3 GeV beams of polarized deuterons with good intensity (approximately 10^{10} d per pulse) and very high vector and tensor polarization. Some experiments which have been recently completed or are planned in a near future are described.

1641 **(JINR—R-2-84-95) Deep inelastic deuteron-proton scattering.** Dorkin, S.M.; Kaptar', L.P.; Titov, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702779.

Submitted to the journal Sov. J. Nucl. Phys.

A theoretical analysis of deep-inelastic dp→ dX reactions is given. The contribution of resonance mechanism is investigated when the nucleon resonances are excited in a target by the multiple quark-quark scattering. This mechanism is found to contribute less than 40% to the cross section. Nonresonance processes are calculated and comparison with available experimental data is given.

6513 Nuclear Properties And Reactions, A=6-19, Theoretical

REFER ALSO TO CITATION(S) 1651

1642 (INIS-mf—9377, pp 13-18) **Microscopic approach to pion production in intermediate-energy heavy-ion collisions.** Tohyama, M.; Kaps, R.; Masak, D.; Mosel, U. (Giessen Univ., Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We have applied our model to pion production in head-on collision of $^{16}O + ^{16}O$, using the TDHF code with axial symmetry. (orig./HSI).

1643 (INIS-mf—9377, pp 65-74) **Hard photons and pions as probes for nucleus-nucleus collisions.** Grosse, E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

Pion and hard photon production data at 48 to 84 MeV/u are inspected according to their possible description in a thermal emission model or as a bremsstrahlung process. (orig./HSI).

1644 (INIS-mf—9377, pp 19-22) **Search for subthreshold K^+ production by ^3He ions of 910 MeV on carbon.** Iazzi, F. (Politecnico di Torino, Italy). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We performed a search for the occurrence of the reaction $^3He + ^{12}C \rightarrow ^{15}sub(lambda)N + K^+$ by taking advantage of the large acceptance Omicron spectrometer. (orig./HSI).

1645 **(ISN—84-34) Inelastic $^{12}C(^{12}C, ^{12}C)^{12}C$ scattering via the Glauber optical potential at E/A=30 MeV and 85 MeV.** Chauvin, J.; Lebrun, D.; Durand, F.; Buenerd, M. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jul 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752932.

It is shown that some approximations implied in the optical limit of the Glauber theory are justified for low energies heavy-ions surface collisions. The Glauber optical potential, with no free parameters, leads to reasonable predictions for both elastic and inelastic scattering in the $^{12}C + ^{12}C$ system.

6514 Nuclear Properties And Reactions, A=20-38, Theoretical

1646 (INIS-mf—9377, pp 29-32) **Channel effects on subbarrier fusion reactions.** Braun-Munzinger, P. (State Univ. of New York, Stony Brook). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

The enhancement of barrier penetrabilities, and thereby of subbarrier fusion cross sections, is by now well established as due to coupling to intrinsic degrees of freedom of the colliding nuclei. In the present contributions it is demonstrated that the experimentally measured enhancement can be quantitatively understood for relatively light systems (Zsub(p) x Zsub(T) <= 700) by means of coupled channel calculations including all strongly coupled, low lying projectile and target excitations. (orig./HSI).

1647 (INIS-mf—9377, pp 1-6) **Pion production as a probe for coherence in medium energy heavy ion collisions.** Stachel, J. (State Univ. of New York, Stony Brook). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We present here recent experimental information which can serve as a probe for cooperative or even coherent effects in heavy ion collisions. Inclusive cross sections for π^0 production have been measured for 35 MeV/u ^{14}N on Al, Ni, W at the MSU K = 500 superconducting cyclotron and for 25 MeV/u ^{16}O on Al, Ni at the HHIRF at Oak Ridge National Laboratory. (orig./HSI).

6515 Nuclear Properties And Reactions, A=39-58, Theoretical

1648 **(CENBG—8501) Measurements of nuclear interaction times in heavy ion collisions.** Chemin, J.F. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). 1985. 13p. (In French). (CONF-8502101—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752931.

From 8. biennial session on nuclear physics; Aussois, France (4 Feb 1985).

We discuss in this paper different approaches using characteristic times of atomic inner-shell processes for measuring the sticking times and the lifetimes of intermediate composites formed in nuclear reactions. After a brief description of the basic principles of these methods we report recent results obtained in the measurements of the sticking times versus the total kinetic energy loss in deep-inelastic nuclear reactions. Then we report on the recent developments in the measurements of the lifetime of nuclear intermediate states formed in fusion-evaporation reactions. The results concerning the influence of the nuclear interaction times on the emission of positrons from super-heavy systems is also discussed.

1649 (INIS-mf—9377, pp 95-100) **Cooperation between one-body and two-body dynamics in the subthreshold pion production at intermediate energies.** Cassing, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

The picture adopted for the heavy-ion dynamics is based on the Wigner transform of the von-Neumann equation, which yields a nonlinear integro-differential equation for the one-body phase-space density. (orig./HSI).

1650 (INIS-mf—9377, pp 101-103) **Microscopic description of the (p,π^-) continuum at intermediate proton energies.** Scholten, O.; Toki, H.; Aichelin, J.; Bonasera, A.; Kaps, R.; Sarafian, H. (Michigan State Univ., East Lansing). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

Continuum spectra of the proton induced π^- production at proton energies of some 200 MeV are studied in a microscopic two-nucleon model. Both structure and absolute magnitude of the pion cross section as a function of the excitation energy are well reproduced. (orig./HSI).

1651 (IPNO-TH—84-73) **Gamow-Teller and M1 strengths in closed-shell nuclei.** Adachi, S.; Lipparini, E.; Nguyen Van Giai. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Oct 1984. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752930.

We study the transition strengths induced by the various operators σ vector, σ vector tau vector, 1 vector tau vector and their combinations in the closed-shell nuclei ^{16}O and ^{40}Ca. The total, inverse energy-weighted and energy-weighted strengths are calculated in perturbation theory. The results are discussed in connection with the available data. A large amount of Gamow-Teller and M1 strength is predicted at high excitation energies.

1652 (JINR—R-4-84-520) **Application of the semimicroscopic coupled channel method to description of low-energy proton scattering by nuclei.** Knyaz'kov, O.M.; Kukhtina, I.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702781.

Submitted to the journal Sov. J. Nucl. Phys. .

A semimicroscopic approach to the description of scattering of low energy protons by nuclei is represented in the coupled-channel approximation. Angular distributions of 27.1 MeV protons inelastically scattered from ^{58}Ni target-nucleus were calculated for $2_1^+>$, $2_3^+>$, $4_1^+>$, and $2_4^+>$ excited states. A good description of the experimental data is obtained, deformation parameters β_2 and β_4 are extracted and the phonon structure of the excited states of ^{58}Ni nucleus is investigated. The effect of both the Pauli principle and the phonon operator second order terms on angular distributions of the inelastically scattered protons is studied.

6516 Nuclear Properties And Reactions, A=59-89, Theoretical

1653 (BNL-NCS—36965) **Reexamination of 2200 meter/second cross section experiments for neutron capture and fission standards.** Holden, N.E.; Holden, K.A. (Brookhaven National Lab., Upton, NY (USA); Carleton Coll., Northfield, MN (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-8508138—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001191.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

Neutron capture and fission reaction cross sections are usually measured relative to a standard basis. The most common absolute cross sections which are used in the thermal neutron energy region are ^{197}Au and ^{59}Co for capture reactions and ^{235}U and ^{239}Pu for fission reactions. Values for these four cross sections have been compiled and evaluated for the purpose of recommending standard values. 24 refs., 5 tabs. (WRF)

1654 (INIS-SU—305, pp 351-355) **Analysis of the width correlation of sup(64,66,68)Zn s neutron resonances.** Knat'ko, V.A.; Shimanovich, E.A. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The role of high-energy direct gamma-transitions in correlation between reduced neutron widths and total gamma-widths of s-neutron resonances in isotopes Zn with A=64, 66 and 68 was investigated an terms of the model used for the description of low-lying levels in the product-nucleus. The results of calculations show that the contribution of the gamma transitions to the mean experimental resonance width increases with the growth of A: for ^{65}Zn, ^{67}Zn and ^{69}Zn the contribution is equal to 27, 53 and 61% respectively.

1655 (INIS-SU—305, pp 115-118) **Forecasting nuclear physical characteristics of short-lived neutron-rich nuclei.** Kolobashkin, V.M.; Aleksankin, V.G.; Lyutostanskij, Yu.S.; Rubtsov, P.M.; Ruzhanskij, P.A. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The way to increase the accuracy of calculation of the radiation characteristics of nuclear fuel by using the microscopic method to describe the β-decay characteristics for a large group ($70 < A < 170$) of the short-lived neutron-rich nuclei is presented. The method based on the theory of finite Fermi systems is used in calculations. Half-life periods of nuclei and total probabilities of delayed neutron emission are given.

1656 (INIS-SU—305, pp 346-350) **Verification of the presence of nonstatistical effects for the partial α-transitions in resonances of the sup(67)Zn(n, α)sup(64)Ni reaction.** Gledenov, Yu.M.; Zhak, A.; Marinova, S.; Mitrikov, M.; Ostrovnaya, T.M.; Popov, Yu.P.; Salatskij, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The time-of-flight method is used to investigate the ^{67}Zn(n, α) ^{64}Ni reaction. Results of measuring the spectra of α-particles in separate ^{67}Zn resonances are presented. Spectra for the 1.546 and 3.789 keV resonances are presented, as well as the temporary spectrum of 4.6 MeV α particles (α_0-transitions). The presence of strong α_0-transitions in the resonances cancels the assumption on the violation of statistic regularities for the α_0 and α_1 transitions in the ^{67}Zn resonances.

1657 (NEANDC(J)—114/U) **Evaluation of neutron nuclear data of natural nickel and its isotopes for JENDL-2.** Kikuchi, Yasuyuki; Sekine, Nobuo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jul 1985. 201p. (INDC(JPN)—100/L; JAERI-M—85-101). JAERI-Information Div., Dept. of Technical Information, Tokai-mura, Naka-gun Ibaraki-ken, Japan. File Number TI85902217.

Neutron nuclear data of natural nickel and its isotopes have been evaluated. Evaluated are the total, elastic and inelastic scattering, capture, (n,2n), (n,3n), (n,p) (n,α), (n,n'p) and (n,n'α) reaction cross sections, the resonance parameters, the angular and energy distributions of secondary neutrons in the energy range from 10^{-5} eV to 20 MeV. The evaluation has been made on the basis of recently measured data with the aid of the spherical optical model and statistical model. The results of the benchmark tests of JENDL-1 have been also taken into consideration. Special care has been taken on the background cross sections in the resonance region, the remaining resonance structure in the unresolved reso-

nance region up to a few MeV, and grouping of the inelastic scattering levels in the natural nickel file. The problems left for future work are also discussed. The results of the present evaluation were adopted in JENDL-2. 154 refs., 74 figs., 15 tabs.

6517 Nuclear Properties And Reactions, A=90-149, Theoretical

1658 (BNL—37078) **Heavy ion induced transfer reactions: a spectroscopic tool for high spin states.** Bond, P.D. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-850942—31). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001739.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

By selectively choosing the appropriate heavy ion transfer reaction one can access high spin states. As a demonstration of the technique two proton and two neutron states of high spin (both yrast and non-yrast) in Nd nuclei have been identified. These spectroscopic results have yielded the first direct information about the configuration of some of these states. 11 refs., 6 figs. (WRF)

1659 (INIS-mf—9375) **Study of the reaction mechanism at the Coulomb threshold.** Setzensack, C. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 23 Feb 1984. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE86780015.

The aim of the present thesis was to study the mechanism of transfer and fission reactions near the Coulomb barrier. For this a ^{64}Ni beam of Esub(lab)=276 MeV was shot on the targets ($^{112\ 118\ 124}$)Sn. By γ activity measurements the absolute cross sections for the different transfer and fission products were determined. In order to separate the disturbing evaporation residue nuclei of the compound-nucleus reactions angular distributions were measured. In the transfer reaction it was of interest how the excitation energy is partitioned between the projectile- and target-like ejectiles. For this purpose the experimental cross sections were compared with theoretical values. The letter were obtained by a Fokker-Planck equation with following inclusion of evaporations by means of the statistical model. In heavy-ion induced fission reactions it is generally known that the presently existing model often predict all too narrow mass distributions; on the example of the reaction ^{64}Ni->^{124}Sn with Esub(lab)=276 MeV this was explicitely demonstrated. A possible explanation for this are mechanisms which yield fission-like fragments without preceeding compound-nucleus formation. Presently two such reaction types are known, namely fast and quasi-fission. For this it was shown that both mechanisms in the previously mentioned example don't exist and so cannot be used for the explanation of the broad mass distribution. (orig./HSI).

1660 (INIS-mf—9377, pp 111-115) **Emission of light charged particles in dissipative collisions at 18 MeV/u incident energy.** Hildenbrand, K.D.; Albinski, J.; Gobbi, A.; Gralla, S.; Herrmann, N.; Kuzminski, J.; Mueller, W.F.J.; Petrovici, M.; Sann, H.; Stelzer, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We have studied protons and α-particles in coincidence with binary heavy fragments in collisions of ^{92}Mo and ^{92}Mo at 18.2 MeV/u. Energy, angle and multiplicity distributions of the light particles have been extracted as a function of excitation energy and mass of the heavy fragments. The proximity scattering in the Coulomb field could be used to deduce a ratio of the sequential to non-sequential decay components and hence to determine a time scale for the decay of these highly excited products. (orig./HSI).

1661 (INIS-mf—9377, pp 23-28) **Reaction studies near the barrier for medium heavy systems: Ni + Sn.** Henning, W. (Argonne National Lab., IL). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

Cross sections for elastic and inelastic scattering, single- and multi-nucleon transfer fusion followed by particle evaporation leaving an evaporation residue, and fusion followed by fission have been measured for sup(58,64)Ni beams incident on even Sn targets at energies from below to above the Coulomb barrier. (orig./HSI).

1662 (INIS-mf—9377, pp 104-110) **Compound nucleus emission of complex fragments at low and intermediate energies.** Moretto, L.G.; McMahan, M.A.; Sobotka, L.G.; Wozniak, G.J. (California Univ., Berkeley). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

Two sets of experiments showing the compound nucleus origin of complex fragments and the Businaro-Gallone transition are presented. (orig./HSI).

1663 (INIS-SU—282, pp 92) **Relative intensities of γ rays and internal conversion coefficients in de-excitation of low-lying states in odd silver isotopes.** Shevelev, G.A. 1984. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE85780893. (CONF-8404189—Summ.).

From 34. conference on nuclear spectroscopy and nuclear structure; Alma-Ata, USSR (17 Apr 1984).

Short note.

1664 (INIS-SU—305, pp 105-109) **Multigroup absorption cross sections of fission products of promethium and samarium isotopes.** Abagyan, L.P.; Zakharova, S.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The capture cross sections of isotopes Pm (147, 148m, 148g, 149, 151), Sm (144, 148, 150, 152, 154, 156) have been evaluated in the energy range from 10-5 eV to 15 MeV for preparing of 80-, 21- and 26-group constants cross sections and involving them into the fission product capture cross section library for reactor calculation. The evaluation is based on the experimental data on neutron cross sections of these isotopes, reported until the middle of 1983 year, and available evaluations of other authors.

1665 (INIS-SU—305, pp 92-104) **Comparative analysis of estimations of cross sections of neutron radiative capture for the main fission products.** Belanova, T.S.; Gorbacheva, L.V.; Grudzevich, O.T.; Ignatyuk, A.V.; Manturov, G.N.; Plyaskin, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The revised neutron capture cross sections for ^{99}Tc, sup(101, 102, 104)Ru, ^{103}Rh, ^{105}Pd, ^{109}Ag, and ^{133}Cs are analyzed using experimental results obtained in recent years. For the fission products direct experimental data revised evaluations are carried out on the basis of the systematics of the radiative strength functions and the isotopical dependence of the capture cross sections. The analysis of experimental data performed and the theoretical description of cross sections with the maximum likelihood method show the accuracy of the latest estimation of fission product capture cross sections in the 1 to 1000 keV neutron energy range to be 10-15%. The comparison of estimates with integral data proves the necessity of coordinating differential and integral cross sections measurements for ^{99}Tc and ^{109}Ag isotopes.

1666 (INIS-SU—305, pp 366-368) **Spin of antimony 121 neutron levels.** Belyaev, F.N.; Bolotskij, V.P.; Borovlev, S.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Spin values were measured for neutron resonances of ^{121}Sb using low-energy levels. The good agreement between measured values of spin and known one is obtained.

1667 (ISN—85-01) **Possible shape-change observed at high spin in ^{123}Cs.** Barci, V.; El-Samman, H.; Gizon, A.; Gizon, J.; Bengtsson, T.; Gono, Y. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752920.

The collective moment of inertia Isub(band)sup((2)) of ^{123}Cs produced in the ^{115}In + ^{13}C reaction at 80 MeV has been measured by gamma-gamma energy correlation techniques. The variations of Isub(band)sup((2)) with the rotational frequency are compared to those of ^{122}Xe and analysed in the frame of a cranked Nilsson-Strutinsky model. We conclude that the addition of one proton to the triaxial (γ approximately equal 30^0) ^{122}Xe core gives a final prolate-type nucleus ^{123}Cs with γ approximately equal to 0^0 above a rotational frequency $\hbar\omega$ approximately equal to 0.55 MeV.

1668 (LBL—20086) **Flow of nuclear matter.** Ritter, H.G.; Doss, K.G.R.; Gustafsson, H.A.; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.; Loehner, H.; Ludewigt, B.; Poskanzer, A.M.; Warwick, A. (Lawrence Berkeley Lab., CA (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1985. Contract AC03-76SF00098. 9p. (CONF-850672—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001484.

From 2. international conference on nucleus-nucleus collisions; Visby, Sweden (10 Jun 1985).

The systems Nb + Nb and Au + Au have been measured at different energies at the Bevalac with the Plastic Ball spectrometer. Distributions of the flow angles as a function of charged particle multiplicity are presented. Also shown is a transverse momentum analysis for 400 MeV per nucleon Nb + Nb. 25 refs., 5 figs., 1 tab.

6518 Nuclear Properties And Reactions, A=150-189, Theoretical

REFER ALSO TO CITATION(S) 1655, 1664, 1730, 1767, 1768

1669 (INIS-mf—9377, pp 218-220) **Two-stage model for fast particle emission in HIC.** Biedermann, M.; Maedler, P. (Technische Univ., Dresden, German Democratic Republic). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We have developed a TDHF-motivated macroscopic model for fast particle emission in binary heavy ion collisions at intermediate incident energies. The trajectory is described by a slightly modified version of a TDHF-motivated phenomenological model. It includes a neck degree of freedom and approximately takes into account memory effects. In the first stage of the collision (before neck formation) we calculate particle emission as in the classical models of refs. Friction force and particle emission rate are determined by one and the same particle (tunnel) flux between the nuclei. In the second stage, after neck formation, we try to mimic the TDHF evolution of the system. (orig./HSI).

1670 (INIS-SU—305, pp 332-337) **Systematics of the nuclear level density in the region of A=150-200.** Antsipov, G.V. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Experimental data on nuclear level density for nuclei with mass numbers in the range of A=150-200 are reviewed using the superfluid model. According to data processing on an excited state density and in accordance with the results of calculations on the superfluid model the systematics of parameters of the constant temperature model is carried out. The neutron resonance density reconstructed according to the model is in good agreement with experimental data.

1671 (INIS-SU—305, pp 361-365) **Search for neutron resonances of the europium 152 isomer (Tsub(1/2)=9.3 h).** Pshenichnyj, V.A.; Vertebnyj, V.P.; Gritsaj, E.A.; Vorona, P.N.; Krivenko, V.G. 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

An attempt was undertaken to study the neutron resonances of isomeric state of ^{152}Eu with Tsub(1/2)=9.3 h in energy range of 0-2 eV. It is possible to suppose the existance of strong isomer neutron resonances at energies 0.039; 0.62; 1.37 eV. These conclusions are preliminary as the observed effects are small.

1672 (INIS-SU—305, pp 25-30) **Production of a symmetric fission mode of preactinide nuclei.** Gruzintsev, E.N.; Itkis, M.G.; Okolovich, V.N. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki); Smirenkin, G.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The variances of fission-fragment mass distributions were measured for (α, f) and (He, f) reactions in the interval between Os and At. The analysis of experimental data shows that the properties of symmetric fission around x approximately equal to 0.7 (Where X-fissionability parameter) are mainly determined by the stage of passing of the fission barrier.

1673 (IPNO-DRE—85-02) **Low-energy transitions in the ^{197}Pb and ^{199}Pb isotopes.** Pautrat, P.; Lagrange, J.M.; Dionisio, J.S.; Vieu, C.; Vanhorenbeek, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1985. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752936.

The ^{199}Pb and ^{197}Pb isotopes are produced through the ^{186}W(^{16}O,4n,5n) reactions. Conversion electron, γ and x spectra are measured using the compound nucleus recoil method. Conversion coefficients and multipolarities are deduced for a large number of transitions. Together with angular distribution measurements and the results of γ-γ-t multidimensional coincidences they lead to decay schemes for the two isotopes. Microscopic calculations, performed in the two or three quasi-particle approximation with a surface delta interaction, fail to reproduce completely the observed properties, showing similar defects for the odd and even isotope.

1674 (JINR—E-4-83-103) **Possible violation of the Gallagher-Moszkowski rule in the sup(160,162)Tm isotopes.** Hons, Z.; Kvasil, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702768.

Analysis of the experimental data on the energy levels and E2, E1 and M1 transition probabilities in the low-lying spectrum on odd-odd sup(160,162)Tm isotopes has been performed in the framework of the "two-quasiparticle+rotor" model. The assignment of the 5/2[402]sub(p-)3/2[521]sub(n) configuration (violating the Gallagher-Moszkowski rule) to the ground state of both nuclei appears to improve significantly agreement of the theoretical f-forbidden E1 transition probabilities with the experimental ones. Interpretation of low-lying levels in both studied nuclei, which improve the description of experimental data in comparison with previous papers, is proposed. The proposed way of theoretical interpretation makes

possible extracting the information from experiment about the intrinsic modes of nuclear motion and provides in such a way the data for testing the nuclear models of odd-odd nuclei.

1675 (JINR—R-4-84-695) **About octupole states in the ^{159}Dy and the ^{169}Er nuclei.** Kvasil, Ya.; Chariev, M.M.; Choriev, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702774.

The properties of negative parity low-lying states in ^{159}Dy and ^{169}Er in the random phase approximation based on the cranking model are investigated. Octupole-octupole forces have been used as a residual interaction. Calculated energy levels are compared with the experimental ones, and also with the energy values obtained with making allowance for dipole-dipole, octupole-octupole and dipole-octupole type forces. The resuits of calculation by the used model permit an understanding of the nature of negative parity low-lying states.

1676 (LYCEN—8345) **Neutron emission in heavy ion induced reactions at 10 MeV/A.** Benrachi, F. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 85p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE85752923.

The neutron emission mechanism in reactions induced by heavy ions (in which a high energy component had already been observed) has been investigated. To get informations on the desexcitation mode which is responsible of that component and on the sharing of the excitation energy between the fragments, a very disymmetric system ^{14}N+^{165}Ho at E inc=10,5 MeV/a.m.u. was studied. The neutrons are preferentially emitted forward in the direction of the quasi-projectile and are in average highly energetic. The calculations of the excitation energies and of the multiplicities showed that the detected events are mainly coming from peripheral processes with a weak angular momentum exchange. The analysis of the energy spectra and of the invariance cross section maps pointed out a strong asymmetry and then proved that at least two neutron sources were involved in that reaction mechanism. Studying these two components in terms of a sequential mechanism i.e. an emission from the totally equilibrated quasi-target and quasi-projectile, the whole neutron emission could not be explained. To interpret the experimental results, non statistical models with a preequilibrium emission at the collision beginning were used.

6519 Nuclear Properties And Reactions, A=190-219, Theoretical

1677 (INIS-mf—9346) **Interaction of 84 MeV/u ^{12}C with ^{208}Pb target investigated with CR-39 plastic track detector.** Grabez, B. (Marburg Univ. (Germany, F.R.). Fachbereich Physikalische Chemie). 8 Mar 1984. 83p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86780016.

The interaction of the 84 MeV/u ^{12}C ions with ^{208}Pb target was investigated using CR-39 plastic track detector. The first part of the work was dedicated to the examination of the methodology of the recently presented CR-39 detector and its calibration. Measurements have been done on tracks of various ions in the broad atomic number region from Z = 2 to Z = 92. The possibility of the identification of low energy fragments produced in nuclear interactions by measurements on the finished tracks was studied. Our results show that very good charge resolution can be achieved through determination of the mean etch rate ratio and the range of low energy ions. In the second part of the work it was shown that the main reaction channels in the interaction of 84 MeV/u C with Pb target are spallation, fission and fragmentation. The contribution of the multifragmentation is less than 1% of the total reaction cross section. From our results follows that the most probable reaction channels after collision with small impact parameter are fragmentation and deep spallation. The spallation and fission come after more peripheral collisions. (orig./HSI).

1678 (INIS-mf—9377, pp 52) **Alpha particles emitted in the ^{197}Au + ^{20}Ne reaction at energy Esub(Ne)proportional1.06 Bsub(c).** Popescu, A.; Popescu, D.G. (Institutul Central de Fizica, Bucharest, Romania). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

1679 (INIS-mf—9377, pp 149-151) **Emission of fast light particles from ^{20}Ne + ^{197}Au reactions at 20 MeV/nucleon.** Machner, H.; Riepe, G.; Protic, D.; Bohlen, H.G.; Fuchs, H. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We have studied the system ^{20}Ne+^{197}Au at E = 20 MeV/nucleon. We have concentrated on the emission of light particles, esp. hydrogen isotopes previously not being studied. Inclusive data have been recorded from 5° to 110° in the reaction plane. Counting rates have been converted into cross sections. (orig./HSI).

1680 (INIS-mf—9377, pp 242-245) **Correlation between energetic light particle emission and linear momentum transfer in heavy ion induced reaction at intermediate energy.** Laville, J.L.; Le Brun, C.; Lecolley, J.F.; Lefebvres, F.; Louvel, M.; Regimbart, R.; Steckmeyer, J.C.; Bertholet, R.; Guet, C.; Heuer, D. (Caen Univ., France). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We have performed at the accelerator SARA in Grenoble, a coincidence experiment with 31 MeV/u ^{16}O projectiles on Au and Th targets, in order to measure the correlations between the energy spectra of light particles emitted in the forward direction and the linear momentum transfered in the nucleus nucleus collisions. (orig./HSI).

1681 (INIS-SU—305, pp 42-46) **Energy spectrum of deep inelastic reaction products with heavy ions in a quasi-fission model.** Vydrug-Vlasenko, S.M.; Konstantinov, B.D. 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The deep inelastic collisions between very heavy ions are considered. The reaction probability is parametrized in the framework of quasi-fission model. The derived expression is used to analyze the experimental spectra. The theoretical calculations of product spectra from the ^{136}Xe+^{209}Bi reaction at the initial energies of 569 and 685 MeV are in good agreement with experimental data.

1682 (INIS-SU—305, pp 19-24) **Asymmetric fission of preactinide nuclei.** Gruzintsev, E.N.; Itkis, M.G.; Okolovich, V.N.; Rusanov, A.Ya.; Tolstikov, V.N. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki); Smirenkin, G.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The paper reports on experimental study of asymmetric fission of preactinide nuclei from ^{213}At to ^{205}Bi in (α, f) and (p, f) reactions on the sup(204, 206, 208)Pb and ^{197}Au nuclei. Information obtained in the experiment makes possible to describe the bulk properties of that new phenomenon. The average mass of a heavy fission fragment weakly varies in a wide range of mass numbers, A, from the average mass values of the heavy fragment M=136-137 amu for ^{205}Bi to M=142 amu for ^{253}Cf, while the mass of a light fragment is considerably shifted towards the mass of a heavy fragment with the A growth. The width of the fission asymmetric component at the half-height of the mass yield curve maximum varies

rather smoothly with the A growth. The asymmetric component contribution to the total yield with the A decrease monotonously drops and sharply and sharply breaks at ^{206}Bi amu-atomic mass unit.

1683 **(IPNO-DRE—84-43) Measurement of ^{147}Gd mass-excess.** Bernas, M.; Langevin, M.; Parrot, G.; Pougheon, F.; Quiniou, E.; Roussel, P.; Dessagne, P.; Schmidt-Ott, W.D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752925.

The mass excess of the ^{147}Gd nucleus was measured from the ^{144}Sm (^{12}C, ^{9}Be) ^{147}Gd reaction using the 72 MeV ^{12}C beam of the Orsay MP Tandem and the "Bacchus" magnetic spectrometer. The derived value of the mass excess of ^{147}Gd is -75.415 +- 0.030 MeV. It is compared with other experimental results and with calculated values.

1684 **(IPNO-DRE—85-03) Transfer in the light Hg isotopes and the U(6/12) models.** Vergnes, M.; Grafeuille, S.; Rotbard, G. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752935.

It was suggested recently that the level schemes of the odd Hg isotopes with 193 <= A <= 199 could be described in the framework of the U(5) limit of the U(6/12) supersymmetry scheme. This suggestion has been further tested using the reactions ^{200}Hg, ^{196}Hg, ^{196}Hg(p,d)^{195}Hg, ^{197}Hg, ^{196}Hg. The comparison of the experimental spectroscopic factors with the ones computed using the U(6/12) model shows that, among the three nuclei studied, ^{196}Hg and ^{197}Hg can be considered as reasonably described. The agreement in this case with U(6/12) is better in the U(5) limit than in the O(6) limit.

1685 **(IPNO-DRE—85-04) Proton excitation of 1^+ states in ^{208}Pb and a lower limit on the strength of the isoscalar spin-flip part of the effective nucleon-nucleon interaction.** Djalali, C.; Marty, N.; Morlet, M.; Willis, A.; Anantaraman, N.; Crawley, G.M.; Galonsky, A. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752933.

Excitation of 1^+ states in ^{208}Pb has been studied by 201 MeV proton inelastic scattering. Strength assigned to 1^+ isovector states is found between 6.0 MeV and 8.2 MeV excitation energies and compared with theoretical predictions. From the cross section of the recently discovered 1^+ "isoscalar" state at 5.846 MeV, a lower limit is extracted for the volume integral of the total equivalent isoscalar spin-flip part of the nucleon-nucleon interaction.

6520 Nuclear Properties And Reactions, A=220 And Above, Theoretical

REFER ALSO TO CITATION(S) 1768

1686 **(BNL-NCS—36953) Status of the translawrencium elements (Z > 103).** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 10p. (CONF-8508138—8). NTIS, PC A02. File Number DE86001176.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

As a result of conflicting claims to the discovery of the trans-lawrencium elements (Z > 103), IUPAC's Inorganic Chemistry Nomenclature Commission, (II.2), has been incapable of coming to a decision on rightful discoverer for these elements. In addition, the Atomic Weights Commission, (II.1), has from time to time been interested in the status of the search for the superheavy elements, i.e., those elements which might be found in the vicinity of the 'island of stability'. Theoretical studies have indicated that the next major shell closures beyond Z = 82 and N = 126 would occur at Z = 114 and N = 184. In recent years, many scientists have devoted their time and effort in an attempt to detect these superheavy elements. This paper will review the literature on both of these developments and provide an up-to-date status report for the use of the Commission. However, this paper will not address the pros and cons of the controversial systematic naming scheme proposed by the Nomenclature Commission, (II.2) and approved by IUPAC. 56 refs.

1687 **(BNL-NCS—36962) Total and spontaneous fission half-lives for americium and curium nuclides.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-8508138—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001745.

From 33. IUPAC general assembly; Lyon, France (30 Aug 1985).

The long-lived nuclides of the americium curium elements are of interest for their use in certain safeguard applications and for nuclear reactor burnup studies in waste management. Recommended values are presented for /sup 241,242m,243/Am, and for /sup 242,243,244,245,246,247,248,250/Cm. These values result from a consistent evaluation of all these half-lives. These preliminary estimates were presented earlier. The uncertainties are provided at the 95% confidence limit for each of the recommended values. It will be noted that many of the recommended errors considerably exceed errors quoted by individual authors in their publication, by up to an order of magnitude, e.g., the total half-life of /sup 242,246,248/Cm and the spontaneous fission half-life of ^{244}Cm. 65 refs., 18 tabs.

1688 **(CEA-CONF—7353) Progress in transactinium isotope neutron data measurements.** Frehaut, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). May 1984. 47p. (CONF-8405229—4). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752281.

From 3. IAEA advisory group meeting on transactinium isotope nuclear data; Uppsala, Sweden (21 May 1984).

This paper reviews the present state of the techniques used in different laboratories for neutron data measurements on transactinium isotopes, with emphasis on recent developments and possible improvements. The different domains investigated are: fission cross sections, prompt neutrons from fission, delayed neutrons from fission, prompt fission neutron spectrum, prompt fission gamma-rays, (n,xn) reactions, capture cross sections and neutron scattering.

1689 **(GSI—85-11) Experiments for the synthesis of neutron-deficient isotopes of elements Z = 102 up to Z = 105.** Hessberger, F.P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Apr 1985. 149p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85752695.

At the velocity filter SHIP of the Society for Heavy Ion Research in Darmstadt the production of transfermium isotopes in fusion reactions ^{50}Ti + ^{207}Pb, ^{208}Pb, ^{209}Bi as well as ^{48}Ca + ^{206}Pb, ^{208}Pb was studied. Hereby entirely four new isotopes ^{257}105, ^{258}105, ^{254}Lr, and ^{255}Lr could be identified via their alpha decay. Of two further isotopes, ^{256}104 and ^{255}104, of which hitherto only spontaneous fission was detected, for the first time α decay was observed. The observation of α decay of ^{256}104 allows to determine the mass excess of the N-Z = 48 isotope chain up to the element 106. The slope of the spontaneous-fission half-lives was studied especially with regard to those isotopes at which the external fission barrier vanishes, i.e. decreases below the ground state. For the latter isotopes an empirical formula for the description of the spontaneous-fission half-lives is proposed. A determination of the total kinetic energy of the fission products for the spontaneous-fissioners ^{256}104 and ^{258}104 yielded values which are compatible with the predictions of empirical systematics. The analysis of the excitation function for evaporation-residue nucleus formation measured for the system ^{50}Ti + ^{208}Pb shows strong indications that the complete fusion near the fusion barrier calculated from conventional models is strongly suppressed.

1690 (INIS-mf—9377, pp 123-128) **Mass distributions of products in reactions leading to the composite systems with Z=108.** Lukyanov, S.M.; Oganessian, Yu.Ts.; Penionzhkevich, Yu.E.; Sodan, H.; Will, E.; Chubarian, G.G.; Gippner, P.; Seidel, W.; Schilling, K.D. (Joint Institute for Nuclear Research, Dubna, USSR). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

The present paper gives the results of the studies of the mass distribution of products formed in the reactions $^{22}Ne + {}^{249}Cf$, $^{40}Ar + {}^{232}Th$ and $^{58}Fe + {}^{208}Pb$. (orig./HSI).

1691 (INIS-mf—9377, pp 241) **Spontaneous emission of ^{14}C from ^{223}Ra.** Kutschera, W.; Ahmad, I.; Friedman, A.M.; Gindler, J.E.; Henning, W.; Rehm, K.E.; Armato, S.G. III; Ishii, T.; Paul, M. (Argonne National Lab., IL). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

1692 (INIS-SU—305, pp 217-221) **Results of multilevel parametrization of sup(239)Pu neutron cross sections.** Kolesov, V.V.; Luk'yanov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.; Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

In frame of S-matrix formalism the self-consistent multilevel analysis of total and fission cross sections for ^{239}Pu up to the 500 eV is carried out. The corresponding cross sections with account of temperature dependences are used for resonance self-shielding factors calculations in some energy groups.

1693 (INIS-SU—305, pp 227-230) **Average resonance parameters and the sup(240)Pu and sup(242)Pu group constants in the 1-46 keV neutron energy range.** Van'kov, A.A.; Ukraintsev, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.); Toshkov, S.; Yaneva, N. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Different evaluations of the average resonance parameters for ^{240}PU and ^{242}Pu isotopes are considered. The group constants in the unresolved resonance region were calculated at the 1-46 keV neutron energies in the framework of the R matrix formalism. Deficiency of the corresponded experimental data is pointed out.

1694 (INIS-SU—305, pp 231-237) **Evaluation of the sup(232)Th and sup(238)U neutron data in the region of unresolved resonances.** Manturov, G.N.; Lunev, V.P.; Gorbacheva, L.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The description of experimental data for ^{232}Th, and ^{238}U on cross sections-total, radiative capture, elastic and inelastic scattering - in the 1-1000 keV neutron energy range is obtained in the Hauser-Feshbach-Moldauer formalism. Evaluated average resonance parameters are recommended for using in the evaluated nuclear data files for ^{232}Th and ^{238}U. The accuracy of ^{238}U radiation capture cross sections in the range of unresolved resonances is 3-5%. The estimated ^{238}U cross section curve $\sigma\Xi sub(n\gamma)$ (E) in the 40-100 keV neutron energy range is 4-5% lower than the BNAB-MICRO and BNAB-78 estimates; while below 40 keV, it lies between them.

1695 (INIS-SU—305, pp 238-242) **Analysis of the sup(238)U resonance self-shielding in the region of unresolved resonances.** Komarov, A.V.; Luk'yanov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.; Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

For the resonance neutron cross section model simple analytical formulae for Doppler broadening resonances has been obtained. With the help of average in the energetical group parameters one can reproduce cross-section functions necessary for self-shielding evaluation.

1696 (INIS-SU—305, pp 247-250) **Mean characteristics of a resonance structure of the sup(238)U neutron cross sections in the 2-45 keV neutron energy range.** Van'kov, A.A.; Grigor'ev, Yu.V.; Gosteva, L.S.; Ukraintsev, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The results of the statistical analysis for the experimental data on ^{238}U transmission functions in 2-45 keV energy region are given. The evaluation of the mean resonance parameters in the frame of the Breit-Wigner formalism is fulfilled and accordingly estimates of the group constants in BNAB are obtained. The comparison of the results with the table data is made.

1697 (INIS-SU—305, pp 3-7) **Role on initial conditions in a dynamic approach to fission.** Adeev, G.D.; Gonchar, I.I.; Pischasov, N.I. (Omskij Gosudarstvennyj Univ. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Based on the description of fission with Fokker-Planck equation, the variance of the Coulomb energy of fragment repulsion for a classical distribution function of a collective variables is calculated with d-like and equilibrium distribution of collective variables at the saddle point. Theoretical data are given for the ^{236}U nucleus. It is concluded that the calculated values of the Coulomb energy variance are always less than the results of calculations of this value with equilibrium initial conditions.

1698 (INIS-SU—305, pp 110-114) **Effective one-group cross section of the (n,γ) reaction for mixture of uranium and plutonium fission products.** Rubtsov, P.M.; Ruzhanskij, P.A. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Calculated fission product (n, γ)-cross-section following uranium and plutonium fission products by thermal and fission neutrons is presented for different irradiation duration range and cooling times and integral neutron density. Mean cross section of the whole fission product mixture for an effective nucleus decreases with the growth of irradiation duration. Increase of the neutron flux density only accelerates this process.

1699 (INIS-SU—305, pp 264-268) **Microscopic calculation of delayed neutron yield and group constants.** Nemirovskij, P.Eh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The yields and group parameters of the delayed neutrons from neutron-induced fission in a large variety of nuclides from ^{232}Th to ^{248}Cm were obtained by using data of yields of fission products and the fraction of beta delayed neutrons per decay. The good description of experimental data is obtained.

1700 (INIS-SU—305, pp 301-307) **Evaluation of the prompt neutron spectrum shape of the sup(252)Cf spontaneous fission.** Bojtsov, A.A.; Starostov, B.I. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Presented are the results from studies of the spectrum shape of the ^{252}Cf fission neutrons within the energy range of 0.003-15 MeV with account for the data obtained from the precise works carried out over the period from 1978 to 1983 with the use of the differential methods. The obtained data are in agreement with the data of Grundle G.A. and Starostov B.I. in the 07-7 MeV energy range.

1701 (INIS-SU—305, pp 318-323) **Self-consistent description of the (n,nf) and (n,xn) reaction cross sections for transuranium nuclei.** Grudzevich, O.T. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)); Ignatyuk, A.V.; Pashchenko, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.); Maslov, V.M. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The fission cross sections, the excitation functions of the (n, xn) reactions and the spectra of inelastically scattered neutrons are analyzed for ^{235}U and ^{238}U nuclei. The level density parameters and the fission barriers which are needed for the simultaneous description of the existing experimental data are considered. The uncertainties in the parametrization of the precompound neutron emission are discussed.

1702 (INIS-SU—305, pp 37-41) **Fragment yield in the sup(235)U fission by resonance neutrons.** Gundorin, N.A.; Duka-Zojomi, A.; Kliman, Ya.; Krishtiak, J.; Popov, A.B.; Presperin, V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The variations of γ-ray yields from several fission fragments were observed in the fission of ^{235}U by resonance neutrons. The changes of yields, e.g. ^{144}Ba and ^{100}Zr, were observed in some resonances and their relative magnitude reached approximately 40%. No correlation of yield changes with energy or spin of neutron resonances below 23 eV was seen.

1703 (INIS-SU—305, pp 47-51) **Mass and charge distributions of sup(237)Np and sup(239)Pu photofission products.** Kondrat'ko, M.Ya.; Mosesov, A.V.; Petrzhak, K.A. (Leningradskij Tekhnologicheskij Inst. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Peak asymmetry in mass distributions of ^{237}Np and ^{239}Pu photofission products is interpreted as smooth fine structure of correlated product yields. The difference of FWHM for light and heavy product peaks is explained by presence of fission. The fractional independent photofission product yields are in good agreement with systematics on neutron fission.

1704 (INIS-SU—305, pp 52-56) **Probability of the uranium 235 ternary fission with the escape of the long-range alpha particle.** Mostovaya, T.A.; Biryukov, S.A.; Mostovoj, V.I.; Osochnikov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The cross-section ratio of the uranium-235 neutron fission with escape of long-range alpha particles to the binary one is measured in the energy range of 3-300 eV. Experimental results show the absence of ternary fission relative probability dependence on the neutron energy with the accuracy of approximately 1%.

1705 (INIS-SU—305, pp 72-76) **Detailed investigation into the sup(252)Cf spontaneous fission with α particle emission.** Grachev, V.T.; Gusev, Yu.I.; Selverstov, D.M.; Smirnov, N.N. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Energy distributions of α-particles and main fragments in the spontaneous fission of ^{252}Cf were measured in the range of emission angles with respect to the direction of the light fragment (60-120) and the mass ratio of fragments 1.1-2.1. Results are analyzed to obtain the information on the fission dynamics. The totality of the data obtained proves that the ^{252}Cf fission with α-particle emission is largely analogous to ^{236}U fission. Experimental data do not agree with calculations performed within the statistic fission model framework. A less pronounced effect of α-particle rescattering on moving fragments as compared with the case of ^{236}U fission can be explained by a high initial velocity of the ^{252}Cf fission fragments.

1706 (INIS-SU—305, pp 77-81) **Investigation of electrons and γ radiation during the fission of sup(239)Pu by thermal and resonance neutrons.** Popeko, L.A.; Rudnev, Yu.P.; Petrov, G.A. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The differences of the electron and γ-ray spectra for resonance (0.29 eV) and thermal neutron fission of ^{239}Pu have been measured. For the total integral yield differences of the electrons and γ-rays with the energies (140-1100) keV have been obtained the following values (1.53 +- 0.07) x 10^{-3} electron/fission, (1.7 +- 0.8) x 10^{-3} quanta/fission.

1707 (INIS-SU—305, pp 82-86) **Lifetimes of fissile nuclei produced in cascade neutron emission.** Grusha, O.V.; Melikov, Yu.V.; Syutkina, L.N.; Tulinov, A.F.; Yuminov, O.A. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The lifetimes of the fissile plutonium isotope were measured using the shadow effect. These isotopes were produced by bombarding of $^{235}UO_2$ and $^{238}UO_2$ single crystals with α-particle beam and following emission of neutrons. The analysis of the experimental results in the framework of the statistical model of nuclear reactions was performed. Lifetimes of the ^{239}PU, ^{240}Pu and ^{241}Pu as a function of an excitation mean energy are determined.

1708 (INIS-SU—305, pp 87-91) **Emission of fission neutron and γ quanta in the sup(235)U(d,pf) and sup(239)Pu(d,pf) reactions.** Serov, V.I.; Andreev, M.F.; Gladkov, V.V.; Zavgorodnij, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The relative neutrons and γ-quanta of fission yield in the direction of fission fragments movement in ^{235}U(d, pf) and ^{239}Pu(d, pf) reactions at Esub(d)=11.6... 12.4 MeV are being measured. In both cases the correlated irregularities in neutron and γ-quanta yield at close energies of excitation are observed. Emission of neutrons and γ quanta during the fission and the dependence of transverse fission cross sections of some nuclei by neutrons show that fission occur for the specific quasistationary states.

1709 (INIS-SU—305, pp 119-123) **Calculations of some experiments using sup(235)U and sup(238)U systems with spectral neutron constants of BAS.** Vasil'ev, A.P.; Kandiev, Ya.Z.; Chitajkin, V.I. (Chelyabinskij Gosudarstvennyj Univ. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Results of the calculations with BAS constant system of the number experiments on ^{235}U- and ^{238}U-systems are shown. Fission neutron spectra in SC BAS is defined from experiments, which show that this spectra differs from the Maxwell or Watt function. The calculations of neutron leakage spectra for uranium spheres with central 14 MeV sources are carried out. The good agreement of theoretical and experimental data is obtained.

1710 (INIS-SU—305, pp 129-133) **Absolute measurements of the sup(239)Pu fission cross section by 8.5 MeV neutrons.** Arl't, R.; Bone, Kh.; Vagner, V. (Technische Univ., Dresden (German Democratic Republic)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The absolute fission cross section measurements for ^{239}Pu at the neutron energy of 8.5 MeV were performed using the time correlated associated particle method. The preliminary result obtained amounts 2.40+-0.07 b.

1711 (INIS-SU—305, pp 134-136) **Absolute measurements of the sup(234)U, sup(236)U, sup(240)Pu, sup(241)Pu, and sup(243)Am fission cross sections using neutrons of the sup(252)Cf fission spectrum.** Adamov, V.M.; Gusev, S.E.; Drapchinskij, L.V. (Radievyj Inst., Leningrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The fission cross sections of ^{234}U, ^{236}U, ^{240}Pu, ^{241}Pu and ^{243}Am by ^{252}Cf fission spectrum neutrons have been measured. Coincidence method between ^{252}Cf spontaneous fission and/or U, Pu, Am was used. Measurement errors are given.

1712 (INIS-SU—305, pp 137-141) **Measurement of the alpha value on the sup(235)U and sup(239)Pu resonances.** Adamchuk, Yu.V.; Voskanyan, M.A.; Muradyan, G.V.; Simonov, P.Yu.; Shchepkin, Yu.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Absolute measurements of the value α=deltasub(γ)/deltasub(f) on resonances of uranium-235 and plutonium-239 have been made on the basis of multiplicity spectrometry of excited nuclei radiation. The accuracy of obtained α values on most of the resonances is no worse than 2% for uranium-235 and 3% for plutonium-239.

1713 (INIS-SU—305, pp 142-146) **Cross section of the sup(237)Np radiative capture at Esub(n)=0.3-1.9 MeV.** Trofimov, Yu.N.; Nemilov, Yu.A. (Radievyj Inst., Leningrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Activation cross sections for ^{237}Np(n, γ)^{238}Np reaction have been measured at 7 neutron energies between 0.3 abd 2.0 MeV. Neutrons were produced by means of the ^{3}H(p, n)^{3}He reaction using Van de Graaff accelerator. The measurements were made relative capture cross section of ^{197}Au.

1714 (INIS-SU—305, pp 147-152) **Study on the cross section under the fission threshold of the uranium 238.** Lityaev, V.M.; Dulin, V.A.; Korobejnikov, V.V.; Tsibulya, A.M.; Korobejnikova, L.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The measurement of transmission of fission neutrons of ^{252}Cf by the fission chamber in spherical geometry for Fe, Ni, stainless steel and ^{238}U was carried out. The obtained results are compared with calculations carried out by Monte-Carlo method and with another experimental data. Within the limit of error the obtained data are in agreement with known experimental data.

1715 (INIS-SU—305, pp 159-163) **Measurement of the cross section ratio of the sup(238)U and sup(235)U fission by fast neutrons.** Goverdovskij, A.A.; Gordyushin, A.K.; Kuz'minov, B.D.; Mitrofanov, V.F.; Sergachev, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The ^{238}U to ^{235}U fission cross-section ratio were measured. The reactions D(d, n) and T(d, n) produced at electrostatic accelerators were used as neutron sources. The double ionization chamber was used to detect the fission fragments.

1716 (INIS-SU—305, pp 164-167) **Measurement results on sigmasub(n, γ) sup(236)U relative to sigma H(n, n) in the 0.16-1.15 MeV neutron energy range.** Davletshin, A.N.; Tipunkov, A.O.; Tikhonov, S.V.; Tolstikov, V.A.; Tuzhilov, V.V.; Sherman, L.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Cross sections of ^{236}U(n, γ)-reaction have been measured relative to H(n, n) reaction by the activation technique in the energy range from 0.16 to 1.15 MeV. The results have been compared with the evaluated data. Obtained cross section values are in good agreement with the data for the cross section measured relative to σΞsub(n, γ) ^{197}Au.

1717 (INIS-SU—305, pp 168-176) **Measurement of the cross sections for the sup(232)Th(n, 2n) reaction in the 6.8 to 10.5 MeV energy range.** Raics, P.; Daroczy, S.; Csikai, J. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Kiserleti Fizikai Intezet); Erdei, K. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary)); Kornilov, N.V.; Baryba, V.Ya.; Salnikov, O.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

A part of the excitation function of the ^{232}Th/n, 2n/^{231}Th reaction was determined by the foil activation technique for neutron energies of 6.79; 6.98; 7.24; 7.49; 7.99; 8.50; 9.02; 9.49; 9.99 and 10.49 MeV. The neutron flux density was measured by five monitor reactions to study the effects of the background neutrons in details. Activity of the ^{231}Th final nuclei was determined by low energy γ-rays which were detected with a HP Ge-spectrometer.

1718 (INIS-SU—305, pp 177-180) **Experimental determination of thermal cross sections and resonance integrals of the radiative capture of sup(230)Th, sup(231, 232, 233)Pa, sup(236)U, sup(237)Np.** Yurova, L.N.; Polyakov, A.A.; Rukhlo, V.P.; Titarenko, D.E.; Komin, S.F.; Stogov, Yu.V. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

This article deals with experimental determination of neutron thermal capture cross sections and neutron resonance capture integrals of ^{230}T, sup(231, 232, 233)Pa, ^{236}U, ^{237}Np. These data were compared with published data.

1719 (INIS-SU—305, pp 189-192) **Measurement results on sigma(n, γ)sup(237)Np relative to sigmasub(n, γ)sup(197)Au in the 0.16-1.15 MeV neutron energy range.** Davletshin, A.N.; Tipunkov, A.O.; Tikhonov, S.V.; Tolstikov, V.A.; Tuzhilov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Cross section of ^{237}Np(n, γ) reaction have been measured relative to ^{197}Au(n, γ) reaction by the activation technique in the energy range from 0.16 to 1.15 MeV. The results have been compared with the evaluated data. It is shown that the obtained data are in good agreement with the estimation of ENDF/B-5 in the nearly whole energy range.

1720 (INIS-SU—305, pp 213-216) **Measurement of the total neutron cross section and resonance parameters of sup(249)Cf in the 0.02-66 eV energy range.** Anufriev, V.A.; Alekseev, A.B.; Babich, S.I.; Efremov, Yu.V.; Erin, E.A.; Kocherygin, N.G.; Nefedov, V.N.; Nikol'skij, S.N.; Timofeev, G.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The total cross section and resonance parameters for ^{249}Cf are measured within the 0.02-66 eV energy range using the neutron chopper. The Breit-Wigner formula has been used to determine the widths of 43 ^{249}Cf energy levels in the 0.7-66 eV energy range. The average statistic values are obtained that characterize the ^{249}Cf total neutron cross section.

1721 (INIS-SU—305, pp 243-246) **Investigation of a resonance scattering cross section structure of uranium 238 in the 1-100 keV neutron energy range.** Grigor'ev, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.); Bakalov, T.; Ilchev, G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The transmission measurement procedure under the self-indication conditions by the neutron scattering on the uranium 238 in the 1-100 keV neutron energy range are described. The experimental values of self-indication functions, average cross section of scattering and the self-indication resonance factors are given.

1722 (INIS-SU—305, pp 251-253) **Measurement of the sup(135)Xe yield in a fission of uranium isotopes, sup(238)Np and sup(239)Pu.** Teplykh, V.F.; Platygina, E.V.; Petrzhak, K.A.; Smirnov, A.V.; Nebogatikov, V.V.; Solonkin, A.A. (Leningradskij Tekhnologicheskij Inst. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The results are given and the method of measurement of the ^{135}Xe cumulative yield in a fission of ^{233}U, ^{235}U, ^{238}U, ^{239}Np and ^{239}PU by reactor neutrons is described. The method is based on a partial reprocessing of the fission product ^{135}Xe into stable isotope ^{136}Xe and the following analysis of stable Xe isotopes on a mass-spectrometer.

1723 (INIS-SU—305, pp 275-279) **Delayed neutron yields in photofission of heavy nuclei.** Ganich, P.P.; Lendel, A.I.; Sikora, D.I. 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Total yields and separated group yields of the delayed neutron in the photofission of ^{232}Th, ^{233}U, ^{235}U, ^{237}Np, by bremsstrahlung with maximal energy in the region 10-18 MeV are determined.

1724 (INIS-SU—305, pp 280-284) **Experimental study of an energy distribution shape of spontaneous fission neutrons of californium 252.** Blinov, M.V.; Bojkov, G.S.; Vitenko, V.A. (Radievyj Inst., Leningrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The spectrum of ^{252}Cf spontaneous fission prompt neutrons has been measured in the neutron energy range of 0.01-10 MeV by the time-of-flight method using a fast ionization chamber with ^{235}U layers as a neutron detector. The experimental data in the 0.01-5 MeV range of neutron energies on the whole agree with the Maxwell distribution to the +-5% accuracy. In the energy range above 5 MeV a systematic deviation of Maxwell distribution is observed.

1725 (INIS-SU—305, pp 285-289) **Precise measurements of prompt neutron spectra of the sup(252)Cf, sup(233)U, sup(235)U and sup(239)Pu fission in the 0.04-5 MeV energy range.** Nefedov, V.N.; Starostov, B.I.; Bojtsov, A.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The fission neutron spectra of ^{253}Cf, ^{233}U, ^{235}U and ^{239}Pu in the 0.04-5 MeV energy range have been measured at the flight distances of 0.5 m and 1.0 m by the time-of-flight method with a scintillation detector based on the anthracene crystal which has a low energy threshold for neutrons of about 20 keV. It is shown that the neutron yield of the ^{252}Cf and ^{233}U +nsub(T) fission in the 0.04-0.8

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MeV energy range exceeds by 8-10% the neutron in the ^{239}Pu +nsub(T) fission. At the same time the intensity ratio of neutron spectra of the ^{252}Cf, ^{238}U +nsub(T) and ^{233}U +nsub(T) fission is in agreement with the ratio of Maxwell distributions.

1726 (INIS-SU—305, pp 294-297) **Relative measurements of prompt neutron spectra of the sup(233)U + nsub(T), sup(235)U + nsub(T), sup(239)Pu + nsub(T) fission in the 0.01-5 MeV energy range.** Bojtsov, A.A.; Semenov, A.F.; Starostov, B.I. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

By using the time-of-flight method the spectra of ^{233}U + nsub(T), ^{236}U + nsub(T), ^{239}PU + nsub(T) fission neutrons have been measured as related to the ^{252}Cf fission neutron spectrum described by the Maxwell distribution with the parameter of T=1.42 MeV. In relation to this standard, the spectra are in a good agreement with the Maxwell distributions having the parameters of T=1.336 +- 0.035, 1.296 +- 0.035, and 1.382 +- 0.035 MeV, respectively.

1727 (INIS-SU—305, pp 298-300) **Precise measurements of the prompt neutron spectrum of the sup(252)Cf fission in the 0.01-3 MeV energy range.** Bojtsov, A.A.; Starostov, B.I. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The ^{252}Cf fission neutron spectrum was weasured by the time-of-flight method. The scintillation detector with an anthracene crystal and the ionization chamber with the ^{238}U layers were used as the neutron detectors. Within the energy range of 0.01-3 MeV the spectrum can be described by the Maxwell distribution with the parameter of T=1.417-0.026 MeV.

1728 (INIS-SU—305, pp 313-317) **Spectra of γ rays from the sup(238)U(n, γ)sup(239)U at the neutron capture with the mean energy from 2.24 to 55 keV.** Murzin, A.V.; Libman, V.A.; Kononenko, I.V.; Lubchenko, N.A.; Kharakoz, I.N. 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

In the γ-ray spectra from averaged resonance capture of 2.24 and 55 keV neutrons by ^{238}U, significant fluctuations of the averaged partial cross section for the primary transitions to the states with Jsup(π)=1/2$^-$, 3/2$^-$ were observed for 24 keV neutrons. It is supposed that fluctuations of γ-transition intensities at the energy of E=24 keV are related to existence doorway states for ^{239}U.

1729 (INIS-SU—305, pp 193-196) **Measurement of the cross section ratios of the ^{236}U and ^{235}U fission by neutrons with the energy of 5.7-10.7 MeV.** Goverdovskij, A.A.; Gordyushin, A.K.; Kuz'minov, B.D.; Mitrofanov, V.F.; Sergachev, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Measurement of fission cross section for ^{236}U by 5.7-10.7 MeV neutrons have been carried out by the pulse-synchronization method. Measurement accuracy was better than 1.5%. Measurement errors are given. The spread of experimental data according to the cross section ratio of the fission obtained by different groups is equal to 5-7%.

1730 (JINR—E-4-84-187) **Description of Tsub(>) giant dipole resonances in deformed nuclei.** Solov'ev, V.G.; Sushkov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702770.

Submitted to the journal Bull. Acad. USSR, Sci. Phys. Ser. .

The characteristic properties of the Tsub(>) component of the dipole giant resonance for deformed nuclei of rare-earth and actinide regions are calculated within the quasiparticle-phonon nuclear model. The centroid energy of T resonance for rare-earth nuclei is (23-25) MeV; and for nuclei in the actinide region, (27-28) MeV. The splitting between Tsub(>)) and Tsub(<) components of the giant dipole resonance is (6-15) MeV. The ratio of photoabsorption cross sections for Σsubi-1)(Tsub(>))/ Σsub(-1)(Tsubltf)) is 0.001 and 0.0.

1731 (NEANDC(J)—115/U) **Evaluation of neutron nuclear data for ^{249}Bk and ^{249}Cf.** Kikuchi, Yasuyuki; Nakagawa, Tsuneo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Sep 1985. 88p. (INDC(JPN)—101/L; JAERI-M—85-138). JAERI-Information Div., Dept. of Technical Information, Tokai-mura, Naka-gun, Ibaraki-ken, Japan. File Number TI86900107.

Neutron nuclear data of ^{249}Bk and ^{249}Cf have been evaluated in the energy range from 10^{-5} eV to 20 MeV. Evaluated quantities are the total, elastic and inelastic scattering, fission, capture, (n,2n), (n,3n) and (n,4n) reaction cross sections, the resolved and unresolved resonance parameters, the angular and energy distributions of the emitted neutrons, and the average number of neutrons emitted per fission. The fission cross sections were evaluated mainly on the basis of measured data. The other cross sections were calculated with the optical and statistical models because of scarce measured data.

6530 Nuclear Theory

1732 (CRN-PN—83-17) **Many-body monopolar forces.** Cortes, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1984. 231p. (In French). NTIS (US Sales Only), PC A11/MF A01. File Number DE85752841.

We show that realistic interactions derived from Brueckner calculations based on the N-N potentials, give excellent spectroscopy provided their monopole behaviour is corrected. The latter is related to saturation properties of nuclei and demands the introduction of a non analytic dependence of the effective interaction on the particle number. This mechanism is certainly related to a density dependence and no need is felt empirically of forces of rank higher than two. Some new results concern the theory of spectral distributions: the parametrization of the monopole feld and calculations of traces of H and H^2 at fixed n,t,v (number, isospin, seniority). These results are useful in the context of quasiconfiguration theory to establish the foundations of Shell Model calculations in the ZBM spaces.

1733 (CRN-PN—84-02) **Isoscalar giant vibrations in the quantized time-dependent deformed oscillator model.** Caurier, E.; Drozdz, S.; Plossajczak, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1984. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85752927.

The gauge-invariant quantization prescription is applied to the solutions of the time-dependent deformed oscillator model (TDDOM) for the isoscalar giant multipole resonances in light atomic nuclei. The quantized TDDOM results are in good agreement with those obtained in the generator coordinate method (GCM). The problems found in the application of the gauge invariant quantization method to the non-separable Hamilton systems are presented.

1734 **(DOE/ER/10419—4) Research in theoretical nuclear physics. Progress report.** Robson, D. (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1985. Contract AS05-79ER10419. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001955.

A summary of results and findings for the past three years is reported. The goal of the work is to derive a successful theory for nuclear physics, and in this effort models are used which are based on a lattice gauge approach to Quantum Chromodynamics. Major results are presented for work in areas of relativistic wave equations, nucleon-nucleon systems, charmonium and upsilonium, and relativistic quark models with chiral symmetry. Future work and collaborations are discussed. 17 refs. (WRF)

1735 **(IFIN-FT—249-1984) One-particle parity-nonconserving nuclear potential.** Caprini, I.; Micu, L. (Institutul Central de Fizica, Bucharest (Romania)). Oct 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702767.

We derive a new one-particle parity-nonconserving term in the nuclear hamiltonian. It is generated by the weak radiative corrections to the interaction of a nucleon with the strong nuclear potential and is analogous to the modification of the Coulomb potential leading to the atomic Lamb shift.

1736 **(IFIN-NP—32-1984) Approximate wave functions, penetration factor and reduced width for the Woods-Saxon well plus the Coulomb barrier potential.** Grama, C.; Grama, N.; Zamfirescu, I. (Institutul Central de Fizica, Bucharest (Romania)). Jun 1984. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702777.

Based on the method of matched asymptotic expansions, the approximate wave functions, penetration factor and reduced width for the Woods-Saxon well plus the Coulomb barrier potential are obtained.

1737 (INIS-mf—9377, pp 7-12) **Pion and hard photons from co-operative effects in intermediate energy heavy ion collisions.** Shyam, R.; Knoll, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

A statistical model is described to investigate the particle production in the intermediate energy heavy ion collisions. In this model the co-operative action of several of the target and projectile nucleons in the particle production process in invoked. The model has been used to study the pion and photon production in nuclear collisions. There are indications that the mechanisms of the production of pions and photons could be quite similiar. (orig.).

1738 (INIS-mf—9377, pp 44-46) **Fads and facts on sub-barrier fusion.** Krappe, H.J. (Hahn-Meitner-Institut fuer Kernforschung, Berlin G.m.b.H., Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

I sketch the general frame of a semi-phenomenological treatment of the process where the numerical effort remains quite moderate. (orig./HSI).

1739 (INIS-mf—9377, pp 53-55) **Fusion and capture within the surface friction model.** Froebrich, P. (Hahn-Meitner-Institut fuer Kernforschung, Berlin G.m.b.H., Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

In this contribution we present the results of applications of the surface friction model to $^{238}U+...$ capture data. (orig./HSI).

1740 (INIS-mf—9377, pp 75-94) **Isospin effects in pionic bremsstrahlung emitted from tin-isotopes.** Uhlig, M.; Vasak, D. (Frankfurt Univ., Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

In heavy ion collisions one observes the production of pions far below the free nucleon-nucleon threshold. One model to explain that cooperative production mechanism is the bremsstrahlung model. In the context of that model we discuss whether the pion yield will significantly be influenced if one changes from tin targets with small neutron numbers to neutron rich tin targets. Based on our model of statistical isospin fluctuations we find out that - depending on geometrical assumptions - the effect can provide a significant enhancement of the pion yield up to 50%. (orig.).

1741 (INIS-mf—9377, pp 129-136) **Hidden dynamics of heavy ion evolution: is it more interesting than our phenomenologies assume.** Griffin, J.J.; Bronlowski, W. (Maryland Univ., College Park). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

Explicit calculations of the early time behaviour in a DOUBLE-WELL Schroedinger model of deep inelastic nucleon exchange contradict the ubiquitous assumption of statistical phenomenology that the total energy defines the driving force for the nucleonic drift. The disturbing question thereby arises whether these phenomenologies may sometimes yield agreement with experimental data even when their physical premises are fundamentally erroneous. For the quantal DOUBLE-WELL model, the expansive pressure of the nucleonic kinetic energy (kinetic pressure) is found to be the primary determinant of the early time behaviour, implying that nucleonic kinetic energy is more effective in promoting nuclear flow than nucleonic potential energy. This implication is verified by explicit calculations for various kinetic and potential energy situations. It follows that the early-time transfer process may be dominated by a combination of neutron and proton flows which tend to move the system towards the equilibria of the neutron and proton kinetic pressures, respectively. Since in general the kinetic pressures of neutrons and protons are simultaneously equilibrized only for a symmetric dinucleus, these independent and irreconcilable tendencies imply a drift which differs from the total energy driven drift. In fact, we calculate that the resulting Equilibria Channeled N-Z Flow should exhibit an (N,Z) drift which is opposite to that implied by the total energy surface, but which is qualitative agreement with the observed behavior of several heavy ion reactions. (orig.).

1742 (INIS-mf—9377, pp 137-148) **Dynamics of the fusion process.** Blocki, J. (Institute for Nuclear Studies, Swierk, Poland). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

The classical dynamical calculations of the collisions of two nuclei leading to their fusion are presented. An extra and extra-extra push energies for different combinations of the target and projectile nuclei are established. A scaling which goes with an arithmetic average of the fissility and the effective fissility parameters is proposed. (orig.).

1743 (INIS-mf—9377, pp 210-217) **Do nuclei stop at intermediate energies.** Aichelin, J.; Stoecker, H. (Oak Ridge National Lab., TN). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

The Vlasov equation and the TDHF method are used to study the mean field dynamics of intermediate energy nuclear collisions. A very similar time evolution of the single particle distribution functions in phase space is observed in the two approaches. Both theories predict transparency and, consequently, forward-backward peaked light particle spectra for C (20-80 MeV/N) + C reactions, in stark contrast to recent experimental data. The inclu-

sion of a Uehling-Uhlenbeck collision integral into the Vlasov equation results in a dramatic change of the reaction dynamics: complete nuclear stopping and formation of a highly excited nuclear system is predicted. Isotropic, exponentially decreasing light particle spectra are obtained, in agreement with recent data. (orig.).

1744 (INIS-mf—9377, pp 221-240) **Pairing vibrations and sub-barrier fusion reactions.** Broglia, R.A. (Niels Bohr Inst., Copenhagen, Denmark). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

The coupling of the entrance channel to inelastic channels can decrease the Coulomb barrier Esub(B) by a quantity D, of the order of few MeV. In regions of the mass table with well developed pairing vibrations or rotations further reductions, of the order of (0.1 - 0.3) D, may arise from the coupling of the entrance channel to two-nucleon transfer channels. (orig.).

1745 (INIS-mf—9377, pp 177-181) **Spin-isospin strength in the quark model.** Abbas, A.; Beck, F.; Richter, A. (Technische Hochschule Darmstadt, Germany, F.R.). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We look into the problem of the spin-isospin excitations in nuclei within a framework of the nonrelativistic quark model with the help of various sum rules. (orig./HSI).

1746 (INIS-mf—9377, pp 249-251) **Catapult mechanism for fast particle emission.** Maedler, P. (Joint Institute for Nuclear Research, Dubna, USSR). 1985. NTIS (US Sales Only), PC A12/MF A01. File Number DE86780007. (CONF-850141—).

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We have investigated the question whether the rapidly snatching inner end of the mean field can act as a catapult, i.e. push out fast nucleons, preferentially along the scission axis. (orig./HSI).

1747 (INIS-SU—282, pp 199) **Problem of eigenvalues of a generalized density matrix (Elliot model).** Belyaev, S.T.; Pavlichenkov, I.M.; Smirnov, Yu.F. 1984. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE85780893. (CONF-8404189—Summ.).

From 34. conference on nuclear spectroscopy and nuclear structure; Alma-Ata, USSR (17 Apr 1984).

Short note.

1748 (INIS-SU—305, pp 338-341) **Calculation of partial radiative neutron resonance widths in the framework of a semiclassical approximation.** Stan'chik, Kh.; Pshitula, M. (Lodz Univ. (Poland). Inst. Fizyki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The semiclassical description has been used to calculate the values of average partial radiative widths for E1-transition to the ground and first excited states of many nuclei. The obtained results have been compared with experimental data for about 40 nuclei. The calculations permit to reproduce the general tendency in the dependence of widths on neutron number of nuclei with sharp maxima for am magic neutron numbers.

1749 (INIS-SU—305, pp 324-327) **Effect of resonance parameter fluctuations in average neutron cross sections.** Koyumdzhieva, N.; Toshkov, S.; Yaneva, N. (IYaIYaEh Bolgarskoj AN). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

In the multilevel model of neutron resonances the common expressions of the mean cross sections are obtained. The factors of resonance parameter statistical fluctuations are calculated. It is shown that resonance parameter fluctuations are too essential for overlapping resonances as for the case of isolated ones.

1750 (INIS-SU—305, pp 328-331) **Comparative evaluation of cross section distribution functions of resonance neutrons inside a group.** Komarov, A.V.; Solov'ev, N.A.; Kolesov, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Resonance neutron cross section distribution inside group functions calculated with the help of equidistant resonance model from the transmission data analysis with corresponding calculations from library ENDF/B-4 are compared. The results are presented for iron, aluminium and niobium. It is concluded that in the region of unresolved resonances the analysis of experimental data on transmission using broad in energy neutron beams is the most reliable source on information on a function of the accumulated probability.

1751 (INIS-SU—305, pp 356-360) **Evaluation of fluctuation effects of neutron widths and energy-level density in calculation of group cross section functionals.** Komarov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Influence of neutron width and energy level density fluctuations in resonance elastic scattering cross sections are considered in transmission and self-shielding calculation. By the Monte Carlo method, errors of using average resonance parameters are evaluated. The fluctuation effects are shown to become insignificant an the case of a great number of resonances being averaged. The application of neutron widths averaged in distributions and energy level densities of resonance parameters is most justified in the range of unresolved resonances where fluctuation effects are small.

1752 (INIS-SU—305, pp 8-13) **Dynamic description of a fission fragment mass distribution.** Adeev, G.D.; Gonchar, I.I. (Omskij Gosudarstvennyj Univ. (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

By using Fokker-Planck equation for collective variables of the quantum distribution function the influence of fission process nonequilibration on the mass variance is investigated. Its dependence on the inertia and friction of mass asymmetry mode is studied.

1753 (INIS-SU—305, pp 62-66) **Role of ternary fission in fusion of bypassed nuclei.** Kramarovskij, Ya.M.; Chechev, V.P. (Radievyj Inst., Leningrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

A possible influence of ternary fission with escape of neutron-entriched light charged particles or example ^{8}He of bypassed nuclides is considered. It is shown that this concept cannot give explanation of bypassed isotope concentrations. But it can make some contribution, if the probability of ternary fission for superheavy nuclei grows sharply with Z^2/A parameter.

1754 (INIS-SU—305, pp 67-71) **Relation of a ternary fission probability to dynamic characteristics of a fissile nucleus at a stage of deseent from a saddle point.** Rubchenya, V.A.; Yavshits, S.G. (Radievyj Inst., Leningrad (USSR)). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Dynamical model is proposed for the production of light charged particles in nuclear fission. The model is based on the assumption that the light particles are formed as a result of two ruptions in a finite radius neck. East neck rapture is assumed and ternary fission configuration parameters are related to parameters of nucleus before fission.

1755 (INIS-SU—305, pp 269-274) **Dependence of total and reduced delayed neutron yields on the (nZsub(c)-Asub(c)) parameter.** Sikora, D.I. 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

The delayed neutrons over the parameter (2.65Z-Asub(c)sup(2) are systematized, where Asub(c) and Zsub(c) are the mass and the atomic numbers of a fissile nuclide. It is shown that this systematic is sensitive to the particularitaes of first group yields.

1756 (INIS-SU—305, pp 57-61) **Ternary fission of heavy nuclei and nuclear reactions with production of three particles.** Nikitin, A.M. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

A kinematically complete experiment on the ternary fission of heavy nuclei is described. The estimates prove that the mass- and energy resolution for ternary fission fragments can be by 30-40% worse than in the double fission. Distributions obtained in such an experiment must provide the data on the interaction between fragments and a light nucleus in their finite state, and thus, on the system initial configuration.

1757 (IPNO-TH—83-33) **Calculation of collective energies from periodic time-dependent Hartree-Fock solutions.** Zahed, I.; Baranger, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jun 1983. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85752919.

A periodic TDHF solution is used as the reference state for a diagrammatic expansion of the propagator. A discrete Fourier transform leads to a function of energy, whose poles are the corresponding energy levels. Limiting the expansion to first-order diagrams leads to a new derivation of the Bohr-Sommerfeld-like quantization rule for collective states.

1758 (IPNO-TH—84-77) **Different interpretation of the nuclear shell model.** Fabre de la Ripelle, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Dec 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752929.

In the first order approximation the nucleons are moving into a collective well extracted from the two-body N-N interaction. The nuclear shell model is explained by the structure of the first order solution of the Schroedinger equation. In the next step the two-body correlations generated by the N-N potential are introduced in the wave function.

1759 (IPNO-TH—85-05) **Nuclear percolation.** Campi, X.; Desbois, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jan 1985. 12p. (CONF-8410210—13). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752928.

From 7. high energy heavy ion study conference; Darmstadt, F.R. Germany (8 Oct 1984).

Nuclear multifragmentation and spallation reactions produced in medium and high energy collisions are viewed as a percolation phenomenon. Percolation criteria are defined in both real and momentum space and a "compactness" condition is imposed to the clusters. Under these conditions, nuclear systems behave like a two-dimensional site percolation model, exhibiting a rather well defined percolation threshold at Psub(C) approximately= 0.6. The concentration p is correlated with the number of fast particles ejected in the first stage of the collision. The mass yield results from the superposition of cluster size distributions at different values of p.

1760 (ISN—84-40) **Wigner transform and semiclassical approximations.** Shlomo, S. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1984. 2p. (CONF-8404274—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752918.

From Workshop on fluid dynamical approaches to many-body problems: fundamental and mathematical aspects; Cantania, Italy (9 Apr 1984).

The Wigner transform provides a reformulation of quantum mechanics in terms of classical concepts. We present some properties of the Wigner transform of the density matrix which justify its interpretation as the quantum mechanical analog of the classical phase space distribution function. Considering some applications, we demonstrate that the Wigner distribution function serves as a good starting point for semiclassical approximations to properties of the (nuclear) many body system.

1761 (JINR—E-2-84-732) **Dibaryons in nuclei.** Mruvchinskij, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702776.

The nuclear matter with an admixture of dibaryon states in thermodynamic and chemical equilibrium at zero temperature is studied. The ideal gas approximation is considered. The role of nuclear forces is discussed. With the help of the pseudopotential method the interaction is included and the dibaryon concentration versus its mass is obtained. The possibility of dibaryon admixtures in nuclei is discussed. The values of such admixtures are estimated. The connection of the problem being considered with the neutron star physics is pointed out.

1762 (JINR—E-4-84-117) **Improved description of the fragmentation of nuclear collective states.** Soloviev, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702769.

Submitted to the journal Sov. J. Nucl. Phys. .

A mathematical method is deveioped for a more accurate description of the fragmentation of one-phonon states forming giant resonances. The method consists in that the one-phonon states already fragmented are used in the two-phonon terms of wave functions. Strength functions are obtained for the excitation of collective charge-exchange states and giant resonances in spherical nuclei.

1763 (JINR—R-2-83-770) **Intranuclear cascade with quark-gluon strings.** Amelin, N.S.; Barashenkov, V.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702778.

Submitted to the journal Sov. J. Nucl. Phys.

High energy intranuclear cascades of hadrons and short-lived physical objects (quark-gluon strings) is considered. The competition of decay processes and interaction of strings with intranuclear nucleons is taken into account. The results of calculating the high energy proton interaction with different atomic nuclei agree with experimental data on the yield of shower particles at a definite width of string breaking.

1764 (JINR—R-2-84-591) **One-channel decay at multiple degeneracy of unstable levels.** Lyuboshits, V.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702700.

The properties of a system of overlapping unstable levels with a single decay channel are discussed. The law of one-channel decay of an N-fold degenerated unsuable system at its excitation by a delta-like wave packet of particles produced under a decay have been derived in an explicit form. In this case the initial state of the system is an eigenstate of the GITA=i(H-H^{+}) decay-matrix with

nonzero eigenvalue which is equal to NGITA(H is the non-Hermitian Hamiltonian, GITA is the width of a quasistationary state). The time dependence of decay probability of other eigenstates of matrix GITA corresponding to the zero eigenvalue is investigated. A complete solution of the problem under the multiplicities of N=2, 3, 4 degeneracy is presented.

1765 **(JINR—R-4-83-225) Procedure of reducing the neutron widths.** Nikolenko, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702771.

Corrections are considered for the ordinarily used operation of reducing the neutron widths. These are due to the change of penetration factor when the R-function making allowance for remote compound levels does not equal zero. This correction has a strong energy dependence for energies more than tens of keV. It depends on accepted boundary conditions B. For B=0 and small neutron energies the account of this correction essentially changes the value of strength function for l=1.2, not changing them for =0.

1766 **(JINR—R-4-84-215) Accounting of the wave function nonorthogonality effect in describing nuclear collisions.** Dzholos, R.V.; Ivanova, S.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702780.

Submitted to the journal Sov. J. Nucl. Phys. .

The method is suggested which takes into account the nonorthogonality of the single-particle wave functions of the colliding nuclei in processes of the heavy ion deep inelastic collisions at 10 MeV/nucleon.

1767 **(JINR—R-4-84-304) Fragmentation of subshells in spherical and deformed nuclei.** Vdovin, A.I.; Malov, L.A.; Nguen Din' Vin'; Solov'ev, V.G.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702772.

Submitted to the journal Nucl. Phys., A.

Fragmentation of single-particle states in spherical and deformed nuclei is studied within the quasiparticle-phonon nuclear model. It is shown that in deformed nuclei the energy interval of localization of the subshell, strength is mainly determined by its splitting due to static deformation. The interaction of quasiparticle and phonon excitations increases its size by 30-40% more. As a result, subshells with orbital momenta l> or approximately 2 in deformed nuclei are fragmented stronger than in spherical nuclei. The dependence of strengtn functions on the excitation energy of the subshells is analyzed. The results of calculations are compared with available experimental data.

1768 **(JINR—R-4-84-399) Description of radiative strength functions of deformed nuclei.** Malov, L.A.; Solov'ev, V.G.; Meliev, F.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702773.

Submitted to the journal Z. Phys., A.

Radiative strength functions of E1R- and M1-transitions from ground states of doubly even deformed nuclei to states near the neutron binding energy Bsub(n), the wave functions of which include one- and two-phonon components, are calculated within the quasiparticle-phonon nuclear model. The calculations were made with the Pauli principle being or not being included in the two-phonon components of the wave functions. It is shown that the radiative E1R- and M1-strength functions as well as the widths of giant dipole resonances in deformed nuclei are slightly influenced by the two-phonon components of the wave functions and they can be calculated in the random phase approximation. The ksub(E1) and ksub(M1)-values are calculated for some deformed nuclei of the rare-earth and actinide region. The calculated values of ksub(E1) are 1.5-2 times larger and the values of ksub(M1) are somewhat less than the average values obtained from the analysis of available experimental data.

1769 (ORNL—6120, pp 155-192) **Theoretical nuclear physics.** Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

The theoretical physics program in the Physics Division at ORNL involves research in both nuclear and atomic physics. In nuclear physics there is extensive activity in the fields of direct nuclear reactions with light- and heavy-ion projectiles, the structure of nuclei far from stability and at elevated temperatures, and the microscopic and macroscopic description of heavy-ion dynamics, including the behavior of nuclear molecules and supernuclei. New research efforts in relativistic nuclear collisions and in the study of quark-gluon plasma have continued to grow this year. The atomic theory program deals with a variety of ionization, multiple-vacancy production, and charge-exchange processes. Many of the problems are selected because of their relevance to the magnetic fusion energy program. In addition, there is a joint atomic-nuclear theory effort to study positron production during the collision of two high-Z numbers, i.e., U+U. A new Distinguished Scientist program, sponsored jointly by the University of Tennessee and ORNL, has been initiated. Among the first appointments is G.F. Bertsch in theoretical physics. As a result of this appointment, Bertsch and an associated group of four theorists split their time between UT and ORNL. In addition, the State of Tennessee has established a significant budget to support the visits of outstanding scientists to the Joint Institute for Heavy Ion Research at ORNL. This budget should permit a significant improvement in the visitor program at ORNL. Finally, the Laboratory awarded a Wigner post-doctoral Appointment to a theorist who will work in the theory group of the Physics Division.

1770 (ORNL—6120, pp 193-197) **Nuclear science applications.** Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

Nuclear science has common frontiers with other basic sciences. The current program concentrates on three areas. (1) In cooperation with the Engineering Physics and Mathematics, Analytical Chemistry, and Computing and Telecommunications Divisions, a program is currently underway to obtain verification of the neutronic and irradiation performance of higher actinides in fast spectrum reactors. This program utilizes the Dounreay Prototype Fast Reactor and will be completed by 1988. (2) In association with the Analytical Chemistry Division, the technique of studying the heavy-ion-induced x-ray satellite spectra has been advanced to the point that it can be applied to metal alloys and other materials of interest to the Metals and Ceramics Division. This program utilizes the EN Tandem and the HHIRF. Significant advances in this area are expected with the construction by early 1985 of an ultra-high-resolution Van Hamos spectrometer. (3) Working with personnel from the Aerospace Corporation, a program to study single-event upsets in integrated circuits has been started. With encouragement from NASA, plans are being drawn up to build a beam line at HHIRF dedicated to this program.

1771 **(UCRL—91947) Calculational tools for the evaluation of nuclear cross-section and spectra data.** Gardner, M.A. (Lawrence Livermore National Lab., CA (USA)). 7 May 1985. Contract W-7405-ENG-48. 13p. (CONF-850507—55). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001559.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

A technique based on discrete energy levels rather than energy level densities is presented for nuclear reaction calculations. The validity of the technique is demonstrated via theoretical and experimental agreement for cross sections, isomer-ratios and gamma-ray strength functions. 50 refs., 7 figs. (WRF)

1772 **(ZfK—537) Spectroscopic investigation of isolated and overlapping resonance states.** Rotter, I. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Oct 1984. 15p. (CONF-8408148—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702775.

From International school of atomic and nuclear heavy ion interactions; Poiana Brasov, Romania (28 Aug 1984).

A correction to nuclear structure calculations due to the finite life time of the excited states of a finite nucleus is investigated. An additional term to the Hamilton operator as well as to the wave function of a nuclear state is shown to appear. The analytical expressions of these terms are given and results of numerical calculations are discussed. The additional term to the Hamilton operator determines the life time of the decaying nuclear states. It violates charge symmetry of the nuclear forces. Its nondiagonal matrix elements describe the external mixing of the states via the continuum by which the properties of overlapping resonances are governed. Long-lived and short-lived states are described in a unified manner. The interplay between giant resonance and underlying levels is studied. The basic assumptions of the statistical nuclear reaction theories are discussed on the basis of numerical results obtained by taking into account the external mixing in a straight forward manner. The additional term to the wave function of a nuclear state describes virtual particles including clusters in the nuclear surface. It plays a role in most nuclear reactions.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 545, 547, 1553

1773 **(CEA-N—2429) Contribution to gamma ray transport calculation in heterogeneous media.** Bourdet, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-11 Univ., 91 - Orsay (France)). Apr 1985. 102p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752838.

This thesis presents the development of gamma transport calculation codes in three dimension heterogeneous geometries. These codes allow us to define the protection against gamma-rays or verify their efficiency. The laws that govern the interactions of gamma-rays with matters are briefly revised. A library with all the necessary constants for these codes is created. TRIPOLI-2, a code that treats in exact way the neutron transport in matters using Monte-Carlo method, has been adapted to deal with the transport of gamma-rays in matters as well. TRINISHI, a code which considers only one collision, has been realized to treat heterogeneous geometries containing voids. Elaborating a formula that calculates the albedo for gamma-ray reflection (the code ALBANE) allows us to solve the problem of gamma-ray reflection on plane surfaces. NARCISSE-2 deals with gamma-rays that suffer only one reflection on the inner walls of any closed volume (rooms, halls..).

1774 **(DOE/EV/01105—320) Extension of carbon kerma factor measurements to 18- and 20-MeV neutron energy.** DeLuca, P.M. Jr.; Barschall, H.H.; Burhoe, M.; Haight, R.C. (Wisconsin Univ., Madison (USA). Dept. of Medical Physics; Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-7405-ENG-48;FG02-84ER40183;AC02-76EV01105. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000845.

Carbon kerma factor measurements were extended to neutron energies of 18 to 20 MeV. Contributions to the data of low energy interactions are identified and subsequently factored out. 12 refs., 7 figs., 2 tabs.

1775 **(IAE—3913/9) Experimental investigation of two-fold elastic-inelastic neutron scattering in lead.** Ivanov, A.S.; Mitrofanov, N.L.; Rumyantsev, A.Yu.; Bobrovskij, V.I.; Goshchitskij, B.N.; Evtukh, A.A.; Zhda khin, I.L.; Kolyadin, V.P.; Mirmel'shtejn, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702725.

A study was made on the problem of the occurrence of peaks in experiments on inelastic neutron scattering. Peaks are conditioned by such processes as neutron scattering on phonons which are forbidden by selection rules but occur due to two fold elastic-inelastic scattering. The occurrence of forbidden peaks for various geometries of scattering in lead was investigated. Simple criteria of evaluating occurrence of multiple scattering with regard to spectrometer resolution and sample mosaic structure were suggested.

1776 (INIS-mf—9766, pp vp) **Channeling study on Mg implanted InSb single crystals.** Alberts, H.W. (Pretoria Univ., South Africa). 1983. NTIS (US Sales Only), PC A02/MF A01. File Number DE86780005. (CONF-8307157—Absts.).

From Symposium on ion implantation; Pretoria, South Africa (11 Jul 1983).

1777 (INIS-SU—283, pp 68-83) **Achievements of neutron physics.** Pasechnik, M.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. (In Russian). NTIS (US Sales Only), PC A15/MF A01. File Number DE85781017. (CONF-8210210—Pt.1).

From Conference on nuclear physics; Kharkov, Ukrainian SSR (4 Oct 1982).

The history of neutron physics (NP) development is reviewed. The role of NP in solving fundamental problems of nuclear physics nuclear power engineering and nuclear technology (NT) is shown. The discovery of the neutron marked the science entry into the nuclear epoch, a decisive change from the quantum atomic theory to the quantum field and elementary particle theories. A wide range of problems in the scope of the NP is related with the range of energies used in neutron experiments (from 10^{-10} eV to 10^{10} eV). Basic neutron properties, differences in electromagnetic neutron and proton structures are considered. Discussed are: the problems of neutron electric dipole moment existence, neutron β-decay, neutron reactions on nuclei, P-parity nonconservation in weak interactions. The NP achievement during the last 25 years contributed to the development of its applied branches in nuclear engineering (NE) and NT. A list of available neutron data necessary for the NE and NT development is presented. New investigations in the field of the nuclear theory and the statistical theory of neutron reactions are discuss.

1778 (INIS-SU—305, pp 124-128) **Calculation of reactor functionals in the region of unresolved resonances for fissile nuclei.** Porodzinskij, Yu.V. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). 1984. (In Russian). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086. (CONF-8310228—Vol.2).

From 6. Soviet national conference on neutron physics; Kiev, USSR (10 Oct 1983).

Two-level model to calculate transmission functionals and self-shielding factors for fissile nuclides in the unresolved resonance region is presented. To similate quasi-resonance cross section structure, average resonance parameters, statistical parameter distributions and gaussian low order quadratare formulae are employed. Theoretical predictions and experimental data for ^{239}Pu are compared.

1779 **(INIS-SU—305) Neutron physics. Proceedings of 6. All-union conference Vol. 2.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; AN SSSR, Moscow; AN Ukrainskoj SSR, Kiev; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1984. 403p. (In Russian). (CONF-8310288—Vol.2). NTIS (US Sales Only), PC A18/MF A01. File Number DE86780086.

From 1. All-Union scientific conference on problems in power thermal technology; Moscow, USSR (1 Oct 1983).

Individual papers are separately abstracted.

1780 **(IRNE—156-1983) Vibrating crystals as possible neutron monochromators.** Stoica, A.D.; Popovici, M. (Institutul Central de Fizica, Bucharest (Romania)). Sep 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702763.

The Bragg reflection of neutrons by vibrating perfect crystals is considered. The additional possibilities offered by the Doppler effect for shaping neutron beams in the k-space are discussed. A simple model for computing the vibrating crystal reflectivity is proposed.

1781 **(JINR—R-3-84-810) Some possibilities of investigations with ultra cold neutrons at pulsed sources.** Pokotilovskij, Yu.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1984. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702764.

Various experimental possibilities of using ultra cold neutrons (lambda > 5 A) at pulsed neutron sources are briefly discussed. The yield of cold neutron flux from a curved mirror neutron guide with a relatively small radius of curvature (300 m) installed on an uncooled moderator of the IBR-2 reactor has been calculated. Possible ways of application of ultracold neutron spectroscopy are indicated. In particular, promising are quasielastic scattering study with the use of correlation spectroscopy at a pulsed reactor, "reflective" type spectroscopy for investigation of one dimensional structures, neutron interferometry with a position-sensitive detector. A variant of spectrometer of very cold neutron inelastic scattering is proposed in which the fluoroflogopit crystal is used as a monochromator.

1782 **(KIYI—84-1) Neutron diffraction by multilayer systems.** Dzyublik, A.Ya.; Rud'ko, V.N. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1984. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702727.

A strict dynamical scattering theory of neutrons by multilayer systems, formed by alternating thin films of two materials, is developed. The statistical distribution of film widths is taken into account. The reflection and transmission coefficients are calculated. The neutron conductivity bands are shown to exist in multilayer systems. For the system of N bilayers a conductivity band consists of N-1 levels. In the absence of absorption such a system becomes completely transparent for neutrons, if the normal component of shear kinetic energy Esub(perpendicular) equals the energy of a conductivity band level. Systems with ferromagnetic films or polarized nuclei polarize neutrons. Multilayer systems can serve as a neutron Fabry-Perot interferometer.

1783 **(LA-UR—85-3276) Relation between finite element methods and nodal methods in transport theory.** Walters, W.F. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 19p. (CONF-850963—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000761.

From International seminar on finite element and allied methods for reactor physics and shielding calculations; London, UK (18 Sep 1985).

This paper examines the relationship between nodal methods and finite-element methods for solving the discrete-ordinates form of the transport equation in x-y geometry. Specifically, we will examine the relation of three finite-element schemes to the linear-linear (LL) and linear-nodal (LN) nodal schemes. The three finite-element schemes are the linear-continuous-diamond-difference (DD) scheme, the linear-discontinuous (LD) scheme, and the quadratic-discontinuous (QD) scheme. A brief derivation of the (LL) and (LN) nodal schemes is given in the third section of this paper. The approximations that cause the LL scheme to reduce to the DD, LD, and QD schemes are then indicated. An extremely simple method of deriving the finite-element schemes is then introduced.

1784 **(OEFZS—4312) Multiple collision solutions for time-dependent neutron transport in slabs of finite thickness.** Windhofer, P. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jan 1985. 36p. (RS—247/85). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702765.

Multiple collision solutions of the time-, space-, and angle-dependent neutron transport equation in slab geometry are given. Two different monodirectional sources have been used: Firstly, a delta(t)-shaped pulse of neutrons (delta(t): Dirac delta distribution) impinging on the slab at time t=0, secondly, a 'rectangular' source, emitting neutrons for a time interval Δt, describing a somewhat more realistic situation. Detailed results up to collision order three are discussed and exhibited in several figures. Interestingly the 'scalar' flux of one times scattered neutrons for the slab problem turns out to be independent of space in the region influenced by the slab boundaries.

1785 **(ORNL/TM—9641) Applications guide to the RSIC-distributed version of the MCNP code (coupled Monte Carlo neutron-photon Code).** Cramer, S.N. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001370.

An overview of the RSIC-distributed version of the MCNP code (a soupled Monte Carlo neutron-photon code) is presented. All general features of the code, from machine hardware requirements to theoretical details, are discussed. The current nuclide cross-section and other libraries available in the standard code package are specified, and a realistic example of the flexible geometry input is given. Standard and nonstandard source, estimator, and variance-reduction procedures are outlined. Examples of correct usage and possible misuse of certain code features are presented graphically and in standard output listings. Finally, itemized summaries of sample problems, various MCNP code documentation, and future work are given.

6550 Medical Physics

REFER ALSO TO CITATION(S) 258, 1250, 1255, 1316, 1411

1786 **(BIPM—81-2) Determination of absorbed dose in a water phantom from the measurement of absorbed dose in a graphite phantom.** Boutillon, M. (Bureau International des Poids et Mesures, 92 - Sevres (France)). 1981. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752165.

We have determined, by calculation, the ratio of the absorbed dose produced in a water phantom to the one occurring in graphite, both for a depth of 5 g/cm^2, with the reference point placed at 1 m from the BIPM ^{60}Co source. This result has then been applied to the experimental measurement of absorbed dose in a graphite phantom in order to obtain the corresponding quantity for water, at the same depth and at the same distance from the source.

1787 **Radiation protection in a pluralistic society.** Meinhold, C.B. (Brookhaven National Lab., Upton, NY (USA)). *Radiological Protection Bulletin;* No. 65, 20-26(Jul 1985).

The relative importance of any particular radiation protection issue may well result from honest and deeply-held convictions which result from different educational, societal, economic and political orientations. This may lead to apparently and truly conflicting national agendas for radiation protection needs. A variety of radiation protection issues in the USA are examined with an understanding that each of us may have a rather singular and isolated perspective. These issues include 'de minimis' probability of causation, risk models, SI units and lifetime dose equivalent.

1788 **ICRP report of the Task Group on Reference Man.** Richmond, C.R. (Oak Ridge National Lab., TN (USA)). *International Journal of Applied Radiation and Isotopes;* **36**: No. 5, 419(May 1985).

Letter to the editor.

6560 Solid-state Physics

1789 **(BNL—37043) Symmetry, stability, and diffraction properties of icosahedral crystals.** Bak, P. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 12p. (CONF-850871—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001196.

From International conference on neutron scattering; Santa Fe, NM, USA (19 Aug 1985).

In a remarkable experiment on an Mn-Al alloy, Shechtman et al. observed a diffraction spectrum with icosahedral symmetry. This is inconsistent with discrete translational invariance since the symmetry includes a five-fold axis. In this paper, it is shown that the crystallography and diffraction pattern can be described by a six-dimensional space group. The crystal structure in 3d is obtained as a cut along a 3d hyperplane in a regular 6d crystal. Displacements of the 6d crystal along 6 orthogonal directions define 6 continuous symmetries for the icosahedral crystal, three of which are phase symmetries describing internal rearrangements of the atoms.

1790 **(ITF—84-70-R) Superlattices of defect density in irradiated crystals.** Sugakov, V.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1984. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702729.

The effects of elastic interaction between the vacancies created by the particle flux are investigated. At the concentration of vacancies exceeding the threshold ones the state of uniform vacancy density is shown to be unstable. In such a case the superlattice of vacancy density arises in crystal.

1791 **(LBL—19160) Morphological stability of continuous intergranular phases.** Carter, W.C.; Glaeser, A.M. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Jul 1985. Contract AC03-76SF00098. 25p. (CONF-850705—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001483.

From 21. University conference on ceramic science; University Park, PA, USA (17 Jul 1985).

A thermodynamic analysis of the morphological stability of continuous intergranular phases, incorporating the number of bounding grains n, and dihedral angle psi as variables is presented. For each n, the minimum thermodynamically unstable wavelength of an infinitesimal amplitude perturbation coincides with the Rayleigh result for psi = 180°, increases with decreasing psi and tends to infinity as psi approaches $\pi - (2\pi/n)$, or equivalently as the interface curvature vanishes. For fixed psi, the stability increases with n. Several applications and implications of the analysis are discussed.

1792 **(LBL—19788) Driving force for sintering of particles with anisotropic surface energies.** Searcy, A.W. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). May 1984. Contract AC03-76SF00098. 12p. (CONF-8405357—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85015132.

From 87. annual meeting of the American Ceramic Society; Cincinnati, OH, USA (8 May 1984).

Crystalline aggregates at constant temperature and pressure are unstable toward shape changes for which $\delta G = [\Sigma(\sigma/\text{sub i}/A/\text{sub i}/+\gamma/\text{sub i}/h/\text{sub i}/)] < 0$ where δG is a differential change in the Gibbs free energy, $\sigma/\text{sub i}/A/\text{sub i}/$ is the free energy of surface or interface i, and $\gamma/\text{sub i}/h/\text{sub i}/$ is the free energy of edge, ledge, or dislocation defect i. The expression reduces to the familiar expression for the driving force for early stage sintering. Line defects play central roles in driving the sintering of crystalline solids.

1793 **(UCID—20530) Mechanism of current modulation by optic phonon emission in heterojunction tunneling experiments.** Hanna, C.B.; Hellman, E.S.; Laughlin, R.B.;. (Lawrence Livermore National Lab., CA (USA); Stanford Univ., CA (USA)). 27 Aug 1985. Contract W-7405-ENG-48. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86002152.

We explain recent observations by Hickmott et al. of sequential longitudinal optic phonon emission in tunneling currents of GaAs-Al/sub x/Ga/sub 1-x/As heterojunctions in terms of inhomogeneous tunneling and a magnetopolaronic mass correction. 16 refs., 13 figs.

6561 Superconductivity

REFER ALSO TO CITATION(S) 869, 871, 886, 891

1794 **(BNL—37019) Critical current studies on fine filamentary NbTi accelerator wires.** Garber, M.; Suenaga, M.; Sampson, W.B.; Sabatini, R.L. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 8p. (CONF-850814—22). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000032.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

The magnets for the Superconductig Super Collider, a high energy proton colliding beam accelerator, require a superconductor with very high current density (>2400 A/mm² at 5 T) and very small filaments (~ 2μm in diameter). Previous work has shown that by controlling the formation of Cu_4Ti compound particles on the filament surfaces it is possible to make fine filamentary NbTi wire with high critical current density. The performance of multifilamentary wire is characterized by the current density and the quantity "n" which describes the superconducting-normal transition. Micrographs of wires having high J/sub c/ and high n show smooth, uniform filaments. Recently wires of very high critical current and high n have been produced in experimental quantities by commercial manufactures.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 1593

1795 **(CASS-FT—250-1984) Nonlinear Boltzmann equation with force term.** Gruenfeld, C.P. (Institutul Central de Fizica, Bucharest (Romania)). Oct 1984. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85702694.

The existence of strict solutions to the initial value problem for the Boltzmann equation with force term is investigated. For a certain class of velocity dependent external forces compatible with equilibrium, and for Grad's generalized hard molecular potentials, the global existence uniqueness, positivity and approach to equilibrium of solutions to the spatially homogeneous Boltzmann equation is proved if the initial data are close to equilibrium (in the sense that the first moments are those of the equilibrium solution and a certain norm of the deviation from equilibrium is small). A local existence theorem is stated in the spatially inhomogeneous case, both for Grad's hard and soft intermolecular potentials. One of the main steps of the argument, concerning the nonlinear part of the theory, is familiarized in an abstract theorem of possible independent interest.

1796 **(CEA-CONF—7550) Use of Hankel transform for axially symmetric problems. Application of finite Hankel transform to the Schroedinger equation.** Bardin, C.; Babuel-Peyrissac, J.P.; Marinier, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Apr 1984. 5p. (CONF-8404144—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752152.

From Modeling and simulation conference; Pittsburgh, PA, USA (19 Apr 1984).

Published in summary form only.

1797 **(CNRS-CPT—84-P-1704) Time dependent quantum systems and chronoprojective geometry.** Burdet, G.; Duval, C.; Perrin, M. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). Dec 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85752938.

Chronoprojective transformations in the framework of the five-dimensional Schroedinger formalism are used to construct the

solution of the Schroedinger equation with a time-dependent harmonic potential from the solution of the free Schroedinger equation.

1798 **(ITEF—64(1984)) Equations of dissipative radiative relativistic hydrodynamics.** Morozov, Yu.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702704.

Equations of relativistic hydrodynamics have been obtained taking into account gas viscosity, and its heat conduction, radiation effects, interacting with gas, and space-time metric, interacting with central gravitational mass. Representation of terms for the first Chapman-Ehnskij approximation has been obtained. The terms describe radiation by means of share and volumetric viscosity emissivity and radiant heat transfer. For such a case relativistic extention of heat and Navier-Stokes equations are obtained taking into account radiation effects.

1799 **(ITF—83-56-R) Characterization of equilibrium states in quantum statistical mechanics.** Kravchuk, N.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1983. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702697.

Some characteristics of the equilibrium states of the quantum statistical systems by using the convexity properties only are investigated.

1800 **(JINR—E-17-84-9) Kinetics of Dicke-type systems.** Bogolubov, N.N.; Fam Le Kien; Shumovsky, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702698.

Submitted to the journal Phys., A.

An exact hierarchy for the Dicke type model problems was obtained. Processes of normal radiation and superradiance were investigated on its basis. Generalization of known semiphenomenological results related to spontaneous radiation was obtained. It is noted that only the simplest consequences of exact hiererchy were studied in the given paper.

1801 **(JINR—R-2-84-86) Interbasis expansions in a two-dimensional hydrogen atom.** Mardoyan, L.G.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702702.

Submitted to the journal Theor. Math. Phys. .

It is shown that the expansion coefficients of the parabolic sub-bases of a two-dimensional hydrogen atom over polar sub-bases are expressed in terms of a generalized hypergeometric function ${}_3F_2$ at the argument x=1. Exapansions of an elliptic basis over the polar and parabolic ones are studied as well. The limits $R \rightarrow 0$ and $R \rightarrow$ infinity (R is a parameter of the definition of elictic coordinates) are traced in elliptic-basis expansions, and formulas are found for the expansion coefficients of the elliptic basis in terms of the elliptic separation constant.

1802 **(JINR—R-2-84-803) Gauge transformation of the creation operators related to the discrete Zakharov-Shabat system.** Vaklev, J.S.; Gerdzhikov, V.S.; Ivanov, M.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702701.

A gauge covariant formulation of the method of expansions over the "squared" solutions of the difference Zakharov-Shabat system is proposed. On this ground the corresponding expansions over the "squared" solutions and the explicit form of the creation operators for the gauge equivalent system are obtained. Thus the main results concerning the difference nonlinear Schroedinger type equations are reformulated for the difference analogs of the Heisenberg ferromagnetic type equations. In particular, the interrelation between the corresponding hierarchies of Hamiltonian structures is established.

1803 **(JINR—R-2-84-843) Some consequences of space-time coordinate relativisation.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702705.

The problem of explicit the introduction of the conventional space parameter into the Lorentz generalized transformations is considered. In the general case of 4-space a possibility of eliminating the parameters of conditional conventions is discussed taking as an example the "Cartesian model" based on locational experience. Within its framework the transition to times of sending and reception of light signals leads to the "light" metric form, all four coordinates being changed. It is noted, from the other side, that in the case of a common (1 + 3) representation the relativistic motion back in time and behaviour of longitudinal dimensions of fast-moving bodies could be considered as direct consequences of 4-vector algebra.

1804 **(JINR—R-4-84-793) Approximation of the differential operator for Faddeev equations by a finite-dimensional operator.** Belyaev, V.B.; Kochkin, V.I.; Kartavtsev, O.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702703.

Possibilities of the method of finite-dimensional approximation of the differential operator are investigated. The approach developed is applied for solving Faddeev equations in the configurational space. The binding energy for three identical spinless particles for the S-wave two-body potential is calculated. The one-dimensional approximation gives a satisfactory energy values.

1805 **(JINR—R-5-84-742) Riemann problem on a plane and nonlinear Schroedinger equation.** Makhan'kov, V.G.; Myrzakulov, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702693.

The scalar nonlinear Schroedinger equation with an arbitrary real coupling constant is integrated by the classical matrix Riemann problem on a complex plane of spectral parameter. Scalar nonlinear Schroedinger equation with an arbitrary real coupling constant is taken as an example to show the structural advantages of a classical matrix Riemann problem on a complex plane of spectral parameter as compared with the more popular today method of inverse scattering problem. A general one-soliton solution of scalar nonlinear Schroedinger equation with an arbitrary real coupling constant is derived. If the coupling constant is positive, then the obtained solutions will pass to a regular soliton. For negative coupling constant a singular soliton is obtained. When the coupling constant equals zero, general solutions will pass to a plane wave. Solutions of singular soliton type will acquire a physical meaning in problems with sources (inhomogeneities).

1806 **(LA-UR—85-3237) Prediction approach to multistage sampling when cluster sizes are unknown.** Kelly, E.J.; Cumberland, W.G. (Los Alamos National Lab., NM (USA); California Univ., Los Angeles (USA)). 1985. Contract W-7405-ENG-36. 10p. (CONF-8508115—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000769.

From American Statistical Association for joint statistical meetings; Las Vegas, NV, USA (5 Aug 1985).

A model for two-stage cluster sampling when sample cluster sizes are unknown is used to derive an optimal (model-based) estimator for the population total and to determine robust sampling strategies. In an empirical study using 1970 and 1980 census data for Los Angeles and surrounding counties, comparisons are made between the model based estimator and conventional estimators. The results favor the new estimator over those derived from randomization theory. In addition, the empirical study shows that the robust sampling strategies suggested by the theory can reduce biases, improve efficiency, and decrease the frequencies of large errors. 7 refs.

1807 **(UFRJ-IF—33/83) Invariance of electromagnetism and the physical meaning of Lorentz-type transformations: a new approach.** Ryff, L.C.B. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702706.

A procedure for the study of true covariances in the case of arbitrary coordinate transformations is outlined and applied to Maxwell equations in the presence of sources. Conceptual consequences are derived.

1808 **Stability of toroidally compact Kaluza-Klein theories.** Blau, S.K.; Guendelman, E.I.; Taormina, A.; Wijewardhana, L.C.R. (Massachusetts Institute of Technology, Cambridge). *Physics Letters [Section] B;* **144B**: No. 1-2, 30-36(23 Aug 1984). Contract AC02-76ER03069.

The authors study the stability at the one loop level, of finite temperature Kaluza-Klein theories coupled to matter fields. They restrict their attention to space-times containing compact manifolds which are toruses and Klein bottles. If the cosmological constant is chosen so that the effective potential vanishes at its minimum, and if twisted bosons or untwisted fermions are introduced into the theory, then these space-times are stable below a critical temperature of the order of the particle masses. The authors also discuss some subtleties that arise when Fermi fields are defined on non-simply connected manifolds.

1809 **Weierstrassian and Levy random walks, and the spherical model of ferromagnetism with long-range interactions.** Hioe, F.T. (St. John Fisher College, Rochester, NY). *AIP (American Institute of Physics) Conference Proceedings;* 85-109(1984). Contract AC02-82ER13012.

A review of the Weierstrassian and Levy random walks and the spherical model of ferromagnetism with long-range interactions, is given. The three problems share the common features of having an infinite mean square correlation length, and of having a singular structure function at the origin. Questions concerning self-similar clustering, transience, persistence, phase transition and long-range correlation are discussed.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 547, 1771, 1783

1810 **(ANL/MCS-TM—54) Algorithms for solving finite dimensional systems of nonlinear equations and inequalities that have both global and quadratic convergence properties.** Burke, J. (Argonne National Lab., IL (USA)). Aug 1985. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001872.

Algorithms for solving finite dimensional systems of nonlinear equations and inequalities that have both global and quadratic convergence properties are presented. The techniques are based upon the Gauss-Newton type algorithms developed for the minimization of the distance function. Under the assumption of a constraint qualification, the algorithms are shown to be quadratically convergent. (GHT)

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 1941

1811 **(DOE/ET/51009—T2) Fusion: science, politics, and the invention of a new energy source.** Bromberg, J.L. (Massachusetts Inst. of Tech., Cambridge (USA)). 1983. Contract AC01-77ET51009. 360p. Massachusetts Institute of Technology, Cambridge, MA 02142 $9.95. File Number TI86001619.

This book provides a historical account of the magnetic fusion program up to the success of the PLT experiment in September 1978. (MOW)

7001 Plasma Research

REFER ALSO TO CITATION(S) 1542, 1925

1812 **(CEA-CONF—7214) Heat diffusion and magnetic field generation.** Holstein, P.A. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Oct 1983. 16p. (CONF-8310404—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752842.

From CECAM workshop on anomalous transport; Orsay, France (1 Oct 1983).

In the report of CECAM workshop in 1982 some results of heat diffusion, when the spontaneous B-field is calculated, have been given. Separately, a similar code (magneto-calo-dynamic or MCD code) has been built and it was interesting to compare them. Comparison has been made during the workshop of October 1983.

1813 **(CEA-CONF—7496) Improvements of high spatio-temporal resolution instruments used for laser-fusion studies.** Launspach, J.; Billon, D.; Cavailler, C.; David, J.; Lebreton, J.P.; Rostaing, M.; Sauneuf, R.; Verrecchia, R. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Aug 1984. 8p. (In French). (CONF-840887—20). NTIS (US Sales Only), PC A02/MF A01. File Number DE85752837.

From 16. international congress on high speed photography and photonics; Strasbourg, France (27 Aug 1984).

Streak cameras are now currently used as a basic tool in the diagnostics instrumentation for laser-plasma interaction studies. We have recently shown at the 15th congress which was held in San Diego the properties of the P 650 soft X-ray camera having both optimized spatial and temporal resolutions (16-20 lp.mm^{-1}, 3 to 5 ps). During 1983-1984 we have continued our efforts to improve and extend the performances of these diagnostics. New developments include: - the used of a cylindrical mirror with the P 650 X-ray streak camera, in order to obtain a streaked soft X-ray imaging device which will be described with some more details in the following paper; - study of a new X-ray streak camera using a modified image converter tube P 750 X with better lamellar optics; - enhancement of photocathode sensitivity by testing new materials; - development of new photocathode-tube window arrangement in order to record both laser and X-ray signals; - another important improvement in the same field is the C.C.D. readout which is presented in other papers.

1814 **(CONF-850806—2) MHD stability of torsatrons using the average method.** Holmes, J.A.; Carreras, B.A.; Charlton, L.A.; Garcia, L.; Hender, T.C.; Hicks, H.R.; Lynch, V.E. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001348.

From Course and workshop on basic physical processes in fusion plasmas; Varenna, Italy (26 Aug 1985).

The stability of torsatrons is studied using the average method, or stellarator expansion. Attention is focused upon the Advanced Toroidal Fusion Device (ATF), an $l = 2$, 12 field period, moderate aspect ratio configuration which, through a combination of shear and toroidally induced magnetic well, is stable to ideal modes. Using the vertical field (VF) coil system of ATF it is possible to enhance this stability by shaping the plasma to control the rotational transform. The VF coils are also useful tools for exploring the stability boundaries of ATF. By shifting the plasma inward along the major radius, the magnetic well can be removed, leading to three types of long wavelength instabilities: (1) A free boundary "edge mode" occurs when the rotational transform at the plasma edge is just less than unity. This mode is stabilized by the placement of a conducting wall at 1.5 times the plasma radius. (2) A free boundary global kink mode is observed at high β. When either β is lowered or a conducting wall is placed at the plasma boundary, the global mode is suppressed, and (3) an interchange mode is observed instead. For this interchange mode, calculations of the second, third, etc., most unstable modes are used to understand the nature of the degeneracy breaking induced by toroidal effects. Thus, the ATF configuration is well chosen for the study of torsatron stability limits.

1815 **(CONF-8509162—6) ICRF wave propagation and absorption in tokamak and mirror magnetic fields: a full-wave calculation.** Jaeger, E.F.; Batchelor, D.B.; Weitzner, H.; Whealton, J.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001350.

From 3. European workshop on problems in the numerical modeling of plasmas; Varenna, Italy (10 Sep 1985).

Global solutions for the ion cyclotron resonant frequency (ICRF) wave fields in a straight tokamak with rotational transform and a poloidally symmetric mirror are calculated in the cold plasma limit. The component of the wave electric field parallel to vector Bis assumed zero. Symmetry in each problem allows Fourier decomposition in one ignorable coordinate, and the remaining set of two coupled, two-dimensional partial differential equations is solved by finite differencing. Energy absorption and antenna impedance are calculated using a simple collisional absorption model. When large gradients in vertical barBvertical bar along vectorB are present in either geometry, ICRF heating at the fundamental ion cyclotron resonance is observed. For the mirror, such gradients are always present. But for the tokamak, the rotational transform must be large enough that vectorB . delB $\geqq$ 0(1). For smaller transforms more typical of real tokamaks, only heating at the two-ion hybird resonance is observed. This suggests that direct resonant absorption at the fundamental ion cyclotron resonance may be possible in stellarators where vectorB . delB $\sim$ 0(1) + 11.

1816 **(DOE/ET/51013—T157) Lower hybrid current drive experiments on the MIT Alcator C and Versator II tokamaks.** Knowlton, S.; McDermott, S.; Porkolab, M.; Takase, Y.; Texter, S.; Bonoli, P.; Fiore, C.; McCool, S.; Mayberry, M.; Chen, K.I. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Aug 1985. Contract AC02-78ET51013. 6p. (PFC/CP—85-6; CONF-850927—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001109.

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Energy confinement studies in lower hybrid RF driven discharges at 4.6 GHz have been carried out on the Alcator C tokamak. The electron temperature profile is measured by a five point Thomson scattering system and the ion temperature by charge-exchange analysis. The energy content of the bulk plasma is found to be similar for RF-driven and ohmic discharges of identical current and density. In the parameter range anti n/sub e/ = 3 - 7 x 10^{13} cm^{-3}, B = 7 - 11 T, I/sub p/ = 100 - 200 kA, q (a) > 8, the RF power needed to sustain the discharge is significantly greater than the ohmic power required to maintain a similar plasma. The gross energy confinement time is lower in the RF-driven discharges than in the ohmic ones by a factor of 1.5 to 4, depending on plasma conditions. The frequency scaling of the density limit for current drive is reported from the Versator II tokamak. The steady-state current drive density limit of anti n/sub e/ = 6 x 10^{12} cm^{-3} at 800 MHz. has been raised to a density of at least anti n/sub e/ = 1.0 x 10^{13} cm^{-3} at the same toroidal field by operations at a frequency of 2.45 GHz. Superthermal electron effects during RF injection are observed up to a density of anti n/sub e/ = 2.5 x 10^{13} cm^{-3}.

1817 **(DOE/ET/53016—86) Nonlinear radial propagation of drift wave turbulence.** Prakash, M. (Columbia Univ., New York (USA). Plasma Physics Lab.). 1985. Contract AC02-76ET53016. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85013664.

We study the linear and the nonlinear radial propagation of drift wave energy in an inhomogeneous plasma. The drift mode excited in such a plasma is dispersive in nature. The drift wave energy spreads out symmetrically along the direction of inhomogeneity with a finite group velocity. To study the effect of the nonlinear coupling on the propagation of energy in a collision free plasma, we solve the Hasegawa-Mima equation as a mixed initial boundary-value problem. The solutions of the linearized equation are used to check the reliability of our numerical calculations. Additional checks are also performed on the invariants of the system. Our results reveal that a pulse gets distorted as it propagates through the medium. The peak of the pulse propagates with a finite velocity that depends on the amplitude of the initial pulse. The polarity of propagation depends on the initial parameters of the pulse. We have also studied drift wave propagation in a resistive plasma. The Hasegawa-Wakatani equations are used to investigate this problem.

1818 **(DOE/ET/53016—88) Tomographic analysis of the evolution of plasma cross-sections.** Holland, A.; Navratil, G.A. (Columbia Univ., New York (USA). Plasma Physics Lab.). Sep 1985. Contract AC02-76ET53016. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001227.

A diagnostic has been developed for measurements of the evolution of plasma density distributions in 2D using the principles of computed emission tomography. The system measures the near infrared emission along several chords through the plasma cross-section and the emission profile is then reconstructed using a maximum entropy based algorithm. This paper will present details of the reconstruction algorithm; the data collection system; the verification of the diagnostic using both physical and numerical phantom sources; evidence for the correlation between n^2 and the infrared emission intensity; initial measurements on a tokamak plasma.

1819 **(DOE/ET/53088—184) Diffusion induced by cyclotron resonance heating.** Riyopoulos, S.; Tajima, T.; Hatori, T.; Pfirsch, D. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Nagoya Univ. (Japan). Inst. of Plasma Physics; Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Sep 1985. Contract FG05-80ET53088. 13p. (IFSR—184-R). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000858.

The wave induced particle transport during the ion cyclotron resonance heating is studied in collisionless toroidal plasmas. It is shown that the previously neglected non-conservation of the toroidal angular momentum IP/sub phi/ caused by the toroidal wave component E/sub phi/ is necessary to allow particle diffusion and yields the leading diffusive contribution. While the induced ion transport for the rf power in contemporary experiments is of the order of the neoclassical value, that of fast alpha particles is quite large if resonance is present.

1820 **(DOE/ET/53088—201) Three dimensional particle simulation of drift wave fluctuations in a sheared magnetic field.** Sydora, R.D.; Leboeuf, J.N.; Thayer, D.R.; Diamond, P.H.; Tajima, T. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Aug 1985. Contract FG05-80ET53088. 15p. (IFSR—201). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000236.

Three dimensional particle simulations of collisionless drift waves in sheared magnetic fields were performed in order to determine the nonlinear behavior of inverse electron resonance dynamics in the presence of thermal fluctuations. It is found that stochastic electron diffusion in the electron resonance overlap region can destabilize the drift wave eigenmodes. Numerical evaluations based on a nonlinear electron resonance broadening theory give predictions in accord with the frequency and growth rates found in the simulation of short wavelength modes (k/sub y/rho/sub s/ $\geqq$ 1).

1821 **(DOE/ET/53088—205) Analytic theory of the nonlinear M = 1 tearing mode.** Hazeltine, R.D.; Meiss, J.D.; Morrison, P.J. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Sep 1985. Contract FG05-80ET53088. 24p. (IFSR—205). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001783.

Numerical studies show that the m = 1 tearing mode continues to grow exponentially well into the nonlinear regime, in contrast with the slow, "Rutherford," growth of m > 1 modes. We present a single helicity calculation which generalizes that of Rutherford to the case when the constant-psi approximation is invalid. As in that theory, the parallel current becomes an approximate flux function when the island size, W, exceeds the linear tearing layer width. However for the m = 1 mode, W becomes proportional to δB, rather than (δB)/sup 1/2/ above this critical amplitude. This implies that the convective nonlinearity in Ohm's law, which couples the m = 0 component to the m = 1 component, dominates the resistive diffusion term. The balance between the inductive electric field and this convective nonlinearity results in exponential growth. Assuming the form of the perturbed fields to be like that of the

linear mode, we find that the growth occurs at 71% of the linear rate.

1822 **(DOE/ET/53088—208) Study of the magnetic compressional mode in a hot particle plasma.** Stotler, D.P.; Berk, H.L.; Engquist, M.G. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Sep 1985. Contract FG05-80ET53088. 25p. (IFSR—208). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001784.

The integral equation for the magnetic compressional mode, accounting for geometrical effects along the field line and using the eikonal approximation across the field line, is solved numerically for the eigenvalues and eigenfunctions. These results reproduce the analytic estimates when there is strong drift reversal. For typical EBT-S parameters, instability is observed for all pressure scale lengths just below those needed for drift reversal, i.e., vertical bar R∂(P/sub c/ + P/sub perpendicular h/)/2B²∂r vertical bar > 1 (where P is the particle pressure, c and h refer to cold and hot components, B is the midplane magnetic field, and R is the midplane radius of curvature). If larger core densities are present, a wave-particle resonance arises when the particle drifts are not reversed, causing instability up to much larger pressure scale lengths. Stability for all values of the ratio of hot electron density to core density is obtained with vertical bar R∂P/sub c//B²∂r vertical bar > 1 + P/sub parallel h//P/sub perpendicular h/.

1823 **(DOE/ET/53193—2-276) Destabilization of global Alfven eigenmodes and kinetic Alfven waves by alpha particles in a tokamak plasma.** Li, Y.M.; Mahajan, S.M.; Ross, D.W. (Texas Univ., Austin (USA). Fusion Research Center). Sep 1985. Contract AS05-85ER53193;AC05-76ET53036. 62p. (FRCR—276). NTIS, PC A04/MF A01; GPO Dep. File Number DE86001678.

Alfven wave instabilities in a reacting tokamak plasma are calculated both analytically and numerically. Two distinct classes of eigenmodes are considered, global Alfven eigenmodes and kinetic Alfven waves, each driven unstable by the free energy associated with the alpha particle density gradient. The growth rates of the global Alfven eigenmodes are given for the first time. These are basically MHD modes, whose resonances with electrons and alpha particles are calculated using kinetic theory. The calculation of kinetic Alfven wave growth rates is improved from earlier treatments. These modes depend on electron inertia and finite ion gyroradius for their existence and have no counterpart in MHD theory. In both sets of calculations toroidal coupling of the alpha particle response to sidebands in the poloidal mode number is fully taken into account. Global modes with small parallel phase velocity are identified as the most dangerous, both because of their substantial growth rates and the expected ineffectiveness of quasilinear stabilization. The kinetic waves, on the other hand, are likely to be stabilized easily by quasilinear flattening of the alpha particle profile. Calculations using both Maxwellian and slowing-down alpha distributions are performed, showing that, for the same alpha density and energy density, comparable growth rates are obtained with each.

1824 **(EUR-CEA-FC—1251) Development of a six channel Fabry-Perot interferometer for continuous measurement of electron temperature of Tokamak plasma. Application to current diffusion study.** Talvard, M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee; Paris-11 Univ., 91 - Orsay (France)). Oct 1984. 269p. (In French). NTIS (US Sales Only), PC A12/MF A01. File Number DE85752813.

It is shown how the properties of the electron cyclotron emission of a tokamak plasma can be used to measure the electron temperature. The design of a six channel Fabry-Perot interferometer is then described. This interferometer allows the measurement of the time evolution of the electron temperature profile of the plasma in the TFR tokamak. Using this technique interesting results have been obtained concerning the current penetration during the start up phase of a tokamak discharge.

1825 **(GA-A—18113) Charge exchange measurements on the Doublet III tokamak.** Lohr, J.; Armentrout, C.J. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1985. Contract AC03-84ER51044. 9p. (CONF-850806—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000311.

From Course and workshop on basic physical processes in fusion plasmas; Varenna, Italy (26 Aug 1985).

Two passive charge exchange analyzers were installed on the Doublet III tokamak. Both were of the E parallel B type, permitting H-D discrimination by mass. Deuterons with energies up to about 90 keV could be observed at the highest spectrometer magnetic fields available. Beam injection energy on Doublet III was typically 75 keV. One of the analyzers could scan across the beam injection angle of approximately 27° at the magnetic axis, while the other analyzer observed parallel neutral flux across nearly the entire cross section from about 10 cm inside the limiter to tangency radii of about 85 cm, intersecting the centerpost. Beam injection was angled toward the direction of positive plasma current and cogoing particles were generally observed by both analyzers. When neutral beam power was increased in steps, generally the observed fast neutral flux did not increase proportionally at higher power levels. In addition, the parallel analyzer in a few cases showed evidence for a fast particle loss at a single energy, with the distribution function being filled in from higher and lower energies. Flux bursts were observed in synchronism with limiter H/sub α/ spikes at the low energy range of the parallel analyzer. The perpendicular analyzer, observing fast particles near their injected pitch angle, detected bursts at all energies, with especially pronounced correlation with H/sub α/ activity at high energies. When fishbone activity was seen magnetically, simultaneous bursts were often, but not always, observed on the perpendicular analyzer, but were never seen on the parallel instrument.

1826 **(IAE—3826/7) Some results of the Compact torus program development.** Es'kov, A.G.; Korshunov, V.K.; Kreshchuk, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 40p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702731.

The paper presents a series of new results of experimental and calculation investigations of the "Compact torus" (CT) concept. Calculation and experimental data on the method of key control under "ballooning" conditions as well as on the problems of heating and suppression of losses at the formation stage are given. Thermonuclear aspects related to the dynamics of burning, energy cycle, etc. are considered.

1827 **(IAE—3832/7) Growth and saturation of spontaneous magnetic fields in the process of plasma corona formaton.** Bol'shov, L.A.; Kiselev, V.P.; Taran, M.D.; Favorskij, A.P.; Yudin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702732.

The paper deals with investigation of magnetic field generation during target heating by high-power laser radiation with regard to ionization kinetics. Consideration of ionization processes during laser heating showed that the basic characteristics of magnetic fields and the physical flow picture in the heated region are described satisfactorily in approximation of a completely ionized plasma. It was established that the value of generated magnetic fields depends weakly on target material. In spite of the different character of heating radiation absorption for the first and the third harmonics of the neodymium laser the qualitative picture of the magnetic field generation in these cases doesn't change. Magnetic field value is more sensitive to characteristics of prepulse forming the initial density profile as compared to the form of basic heating pulse. Magnetic field generation depends sufficiently on the degree of heating radiation focusing.

1828 **(IAE—3840/6) Stochastic motion of ions in field of electromagnetic wave in the conditions of ω=nωsub(ci) in a tokamak.** Shurygin, R.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702733.

Interaction of an electromagnetic wave with ions at ω=nωsub(ci) in a tokamak geometry it considered. Jumps of transverse ion velocity when passing the cyclotron zone in the case of drift and trapped particles were calculated. It is shown that ion motion becomes stochastic in a tokamak during ion interaction with cyclotron oscillations after increasing a certain threshold of electric field amplitude. The regions of stochastic motion in a phase space were calculated. Evaluations of threshold fields show that waves with left polarization are necessary for ion heating by electromagnetic transverse waves. It is necessary to create conditions for mode conversion with formation of counterclockwise polarized waves (ion-hybrid resonance) in the case of using fast magnetoacoustic wave (right polarization).

1829 **(IAE—3854/6) Stochastic instability of particle drift motion in the field of potential oscillations and anomalous diffusion of a plasma.** Krasheninnikov, S.I.; Parail, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702738.

Consideration is being given to the mechanism of the stochastic instability resulting in occurrence of anomalous diffusion of a plasma transverse to the magnetic field. Estimations of the diffusion coefficient in the case of strong turbulence were obtained. The process of anomalous diffusion can be presented in the following way. Oscillations resonant for the given particle form sufficiently complicated cell-type structure in the plane perpendicular to magnetic field and with time-dependent configuration. The change of cell squares in time results in distortion of the adiabatic invariant, particle transition from one cell into another and therefore particle diffusion transverse to the magnetic field.

1830 **(IAE—3860/7) Asymmetry of radiation loss profile in the T-10 tokamak.** Vertiporokh, A.N.; Lyadina, E.S.; Maksimov, Yu.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702734.

The results of experimental study on profile peculiarities of radiation losses in the T-10 facility under the regimes of low stability margin are presented in the paper. Existence of radiation asymmetry by a large radius of the tore during the initial stage of a discharge is pointed out. The conclusion on instability of impurity concentrations on the magnetic surface is made. Mechanisms able to result in asymmetric distribution of impurities are considered.

1831 **(IFTAR-LOP—47-1984) Numerical treatment of the problem of impurity transport in tokamak plasma.** Spineanu, F.; Vlad, M.; Popescu, I.I. (Institutul Central de Fizica, Bucharest (Romania)). Jun 1984. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85702736.

The physical and mathematical aspects of the problem of impurity transport in a tokamak plasma are examined in view of the computer simulation of this process. Regarding the system of equations, some new conclusions are revealed. Then, the system is treated by three different numerical methods, and correspondingly three codes have been written. Detailed description of the methods and various numerical tests are presented as suggestions for the construction of a code for impurity evolution.

1832 **(IFTAR-LOP—49-1984) Collimator type monochromator as a possible impurities monitor for fusion plasmas. Preliminary tests on the Tokamak TM-1-MH.** Musa, G.; Lungu, C.P.; Badalec, J.; Jakubka, K.; Kopecky, V.; Stoeckel, J.; Zacek, F. (Institutul Central de Fizica, Bucharest (Romania)). Sep 1984. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85702737.

A collimator type monochromator has been tested for the first time as the impurity monitor on Tokamak. The possibility to use this type of monochromator in fusion devices is analyzed and a monoslit device is proposed as a convenient monitor for impurities.

1833 **(ITF—84-132-R) Stimulated scattering of electromagnetic waves in plasma-molecular systems.** Goryunova, G.F.; Yakimenko, I.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1984. 39p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702739.

The theory of the stimulated scattering of electromagnetic waves in the combined plasma-molecular systems is developed. The nonlinear scattering current, ponderomotive forces and enhanced scattering spectra are found in the general case of nonequilibrium systems. The simple expressions are obtained for subcritical Brillouin and Raman scattering spectra which demonstrate the influence of molecules on the stimulated scattering phenomena.

1834 **(KFTI—83-25) Influence of nonlocal nonlinearity of the dynamics of strong turbulence of parametrically unstable high-hybrid waves in plasma with inhomogeneous equilibrium parameters.** Aburdzhaniya, G.D.; Brazhnik, V.A.; Demchenko, V.V.; Zhdanov, Yu.A.; Kravtsov, P.I.; Omel'chenko, A.Ya.; Panchenko, V.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702740.

The dynamics of potential finite amplitude high hybrid waves in an inhomogeneous plasma are investigated analytically and numerically. The striction, relativistic and intrinsic plasma nonlinearities as well as nonlinear generation of quasistationary magnetic fields are taken into account. It is shown that for normal dispersion waves the main role in the wave evolution is played by the nonlocal plasma nonlinearity. The emergence of the intrinsic (nonlinear) space scale, related to the nonlocal nonlinearity account, leads to generation of bound multisoliton structures (multisolitons). For waves with anomalous dispersion the Lighthill criterion does not hold, owing to which the soliton generation is absent. A qualitative analysis and numerical investigation of the wave dynamics indicate the emergence of the field self-limitation effect in the resonance zone.

1835 (KIYI—83-4, pp 3-9) **Distribution of ions according to their charge states in a plasma.** Pavlov, S.N.; Khmaruk, V.G. 1983. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780081.

In Actual problems of plasma physics.

Results of calculations of the equilibrium distribution of argon ions according to their charge states are presented. The calculations were conducted with the following assumptions: 1) consideration was given only to the processes of direct and stepwise ionization and to diffuse losses; 2) the time of ion confinement was considered to be independent of the multiplicity factor of the ion charge, ν. A study was made as well on the problem of the effect of electron distribution function versus, f(V), velocities on the ion distribution according to charge states.

1836 (KIYI—83-4, pp 9-13) **Stimulated Mandelstam-Brillouin scattering theory in plasma with account of pumping wave damping.** Salikhov, D.K. 1983. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780081.

In Actual problems of plasma physics.

Stimulated Mandelstam-Brillouin scattering has been investigated in the assumption that the amplitude of a pumping wave decreases due to linear dissipation. The coefficient of reflection from a plasma layer is found. It is shown that reflection doesn't depend on the layer size at a relatively high intensity. The effective size of the region where scattering takes place is determined. Consideration is conducted in the assumption that damping of sound waves is rather intensive.

1837 (KIYI—83-4, pp 13-17) **Investigation of ion acoustic solitons in a plasma-beam system.** Skvortsov, V.A. 1983. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780081.

In Actual problems of plasma physics.

The interaction of a charged particle beam with a nonisothermal plasma (Tsub(i) << Tsub(e)) is considered in the hydrodynamic approximation. The dissipation effects and electron plasma energy as well as variations in the ion acoustic soliton amplitude under the effect of Langmuir waves are neglected at that. Numerical analysis has shown a resonance dependence of the soliton amplitude on the system parameters.

1838 **(KIYI—83-4) Actual problems of plasma physics.** (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780081.

Abstracts of individual items from the report were prepared separately for the data base. (GHT)

1839 **(LA-UR—85-3382) Computation of angle averaged cross sections in a degenerate Compton scattering medium.** Nickel, G.H.; Pochkowski, M.; Bailey, W.F. (Los Alamos National Lab., NM (USA); Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1985. Contract W-7405-ENG-36. 9p. (CONF-8510172—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000806.

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

An accurate yet simple analytic method is developed for calculating Compton scattering cross sections for monoenergetic photons interacting with an isotropic and degenerate distribution of relativistic electrons. 4 refs., 2 figs.

1840 **(LRP—267/85) Strong electron and ion heating in clean conditions in TCA.** de Chambrier, A.; Collins, G.A.; Joye, B.; Lietti, A.; Lister, J.B.; Moret, J.M. (Ecole Polytechnique Federale, Lausanne (Switzerland)). 1985. 33p. (CONF-850927—8). NTIS (US Sales Only), PC A03/MF A01. File Number DE86900009.

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Recent results from the Alfven Wave Heating experiments (2.5 MHz) on the TCA Tokamak show extremely strong sawtooth activity above the AW continuum thresholds. The power deposition profile to the electrons appears to be very peaked in these conditions. Below dominant AW thresholds, we have measured anomalously strong increases in ion temperature, reaching 17 x 10^{13} eV/kWcm^3.

1841 **(LRP—268/85) Textbook finite element methods applied to linear wave propagation problems involving conversion and absorption.** Appert, K.; Hellsten, T.; Vaclavik, J.; Villard, L. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Sep 1985. 70p. (CONF-8509162—4). NTIS (US Sales Only), PC A04/MF A01. File Number DE86900008.

From 3. European workshop on problems in the numerical modeling of plasmas; Varenna, Italy (10 Sep 1985).

A system of two second order ordinary differential equations describing wave propagation in a hot plasma is solved numerically by the finite element method involving standard linear and cubic elements. Evanescent short-wavelength modes do not constitute a problem because of the variational nature of the method. It is straightforward to generalize the method to systems of equations with more than two equations. The performance of the method is demonstrated on known physical situations and is measured by investigating the convergence properties. Cubic elements perform much better than linear ones. In an application it is shown that global plasma oscillations might have an importance for the linear wave conversion in the ion-cyclotron range of frequency.

1842 **(LRP—269/85) Computational models for wave-particle interactions.** Succi, S.; Appert, K.; Core, W.; Hamnen, H., Hellsten, T.; Vaclavik, J. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Sep 1985. 45p. (CONF-8509162—5). NTIS (US Sales Only), PC A03/MF A01. File Number DE86900007.

From 3. European workshop on problems in the numerical modeling of plasmas; Varenna, Italy (10 Sep 1985).

A 2-D finite-element evolution Fokker-Planck code, BACCHUS, is presented. The originally current-drive version and a more recent bounce-averaged version are discussed in some detail. A 1-1/2-D quasilinear code, RUNAWAY, is also described, especially to elucidate the major difficulties arising when the wave-particle interaction is included in a self-consistent way. Finally, some very preliminary information concerning a new 2-D quasi-linear code, presently under development at CRPP, is given.

1843 **(LRP—275/85) Global waves in cold plasmas.** Villard, L.; Appert, K.; Gruber, R.; Vaclavik, J. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Sep 1985. 85p. (CONF-8509162—3). NTIS (US Sales Only), PC A05/MF A01. File Number DE86900010.

From 3. European workshop on problems in the numerical modeling of plasmas; Varenna, Italy (10 Sep 1985).

This paper presents numerical methods developed for the calculation of global wave solutions in cold plasmas, in connection with rf heating in the Alfven and Ion Cyclotron Range of Frequency. Both one-dimensional and two-dimnsional geometries are treated, with special emphasis on the toroidal geometry. A scheme based on a variational formulation and the use of finite hybrid elements is presented in detail. The numerical properties of the computational model are carefully examined. It is shown that an approximate solution with good convergence properties in an exact geometry can be obtained.

1844 (ORNL—6120, pp 198-203) **Plasma diagnostics for fusion program.** Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

Work during the last year included studies on the multichannel polarimetry using Faraday rotation, a collaborative effort to determine the feasibility of measuring plasma edge turbulence and electric fields in magnetically-confined plasmas, and a study on the feasibility of alpha particle diagnostics by CO_2 laser Thomson scattering.

1845 **(ORNL/TM—9507) Calibration of the ORNL two-dimensional Thomson scattering system.** Thomas, C.E. Jr.; Lazarus, E.A.; Kindsfather, R.R.; Murakami, M.; Stewart, K.A. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 71p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86002556.

A unified presentation of the calibrations needed for accurate calculation of electron temperature and density from Thomson scattering data for the Oak Ridge National Laboratory two-dimensional Thomson scattering system (SCATPAK II) is made. Techniques are described for measuring the range of wavelengths to which each channel is responsive. A statistical method for calibrating the gain of each channel in the system is given, and methods of checking for internal consistency and accuracy are presented. The relationship between the constants describing the relative light collection efficiency of each channel and plasma light-scattering theory is developed, methods for measuring the channel efficiencies and evaluating their accuracy are described, and the effect on these constants of bending fiber optics is discussed. The use of Rayleigh or Raman scattering for absolute efficiency (density) calibration, stray light measurement, and system efficiency evaluation is discussed; the relative merits of Rayleigh vs Raman scattering are presented; and the relationship among the Rayleigh/Raman calibrations, relative channel efficiency constants, and absolute efficiencies is developed.

1846 **(PFC/JA—85-27) Trapped electron stochasticity by frequency-modulated waves.** Ram, A.K.; Hizanidis, K.; Bers, A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Aug 1985. Contract AC02-78ET51013. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001315.

It is shown that for electrons trapped in a static potential a finite amplitude frequency-modulated wave induces stochastic motions (and diffusion) in electron orbits over a significantly larger area of phase-space than a single frequency wave of the same amplitude. The wavelength of the FM fields is unimportant if it is greater than twice the width of the static potential. It is proposed

that this be used for pumping of mirror trapped electrons to enhance the confining potential in a tandem mirror cell.

1847 **(PFC/JA—85-29) Electric probes in plasmas.** Lipschultz, B.; Hutchinson, I.; LaBombard, B.; Wan, A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Aug 1985. Contract AC02-78ET51013. 27p. (CONF-851174—11). NTIS, PC A03/MF A01; GPO Dep. File Number DE86001544.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

This paper provides a background for the use of Langmuir and gridded energy analyzer probes in diagnosing plasmas with varied characteristics. Theory is illustrated which governs the analysis of data from, and the design of these probes. Several probe analysis techniques and some of their typical problems are presented.

1848 **(PPPL—2100) Propagation of ion beams through a tenuous magnetized plasma.** Chrien, E.F.; Valeo, E.J.; Kulsrud, R.M.; Oberman, C.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1985. Contract AC02-76CH03073. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002527.

When an ion beam is propagated through a plasma, the question of charge neutralization is critical to its propagation. We consider such a problem where the plasma is magnetized with magnetic field perpendicular to the beam. The plasma-number density and beam-number density are assumed comparable. We reduce the problem to a two-dimensional model, which we solve. The solution suggests that it should be possible to attain charge neutralization if the beam density is properly varied along itself.

1849 **(PPPL—2260) Classification of disruptions in PBX.** Itami, K.; Jahns, G.; Yamada, H.; McGuire, K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1985. Contract AC02-76CH03073. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002533.

Disruptions in beam-heated plasmas on PBX were studied by classifying precursor oscillations detected by a soft x-ray imaging system and Mirnov coils. A data base consisting of 80 discharges was constructed. In low I/sub p/ operation, attainable β/sub T/ values are limited by disruptions preceded by m = 1 activity at the center and coupled an m/n = even/1 mode. In high I/sub p/ and high β/sub T/ operation with high indentation, the sawtooth activity disappears. At these disruptions the plasma loses vertical position or distorts on a relatively fast time scale (<100 microseconds).

1850 **(SAND—85-2126C) Simulator beam control by grad B drift.** Lee, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 51p. (CONF-8510165—2). NTIS, PC A04/MF A01; GPO Dep. File Number DE86001265.

From 6. JOWOG meeting; Aldermaston, England (7 Oct 1985).

This paper presents theoretical analyses of three subjects pertinent to electron beam experiments. First, a new technique for injecting a beam from a triaxial diode is described, and calculations of the phase space acceptance are shown. Second, the interaction of a relativistic electron beam with a low pressure nitrogen gas in a strong magnetic field is discussed in detail. Calculation of the important parameters of the plasma generated by the beam leads to estimates of energy lost by beam electrons during transport. Third, pulse shaping is discussed. To first order, the risetime of the electron beam current after transport is infinitesimally small. Practical limits on the current risetime come from several second order effects, which are considered.

1851 **(UCID—20500) CBEAM.2-D: a two-dimensional beam field code.** Dreyer, K.A. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000834.

CBEAM.2-D is a two-dimensional solution of Maxwell's equations for the case of an electron beam propagating through an air medium. Solutions are performed in the beam-retarded time frame. Conductivity is calculated self-consistently with field equations, allowing sophisticated dependence of plasma parameters to be handled. A unique feature of the code is that it is implemented on an IBM PC microcomputer in the BASIC language. Consequently, it should be available to a wide audience.

1852 **(UCRL—15719) Alpha-particle-driven instability of alfven waves in a tandem mirror. Final summary report, 21 February-20 May 1985.** Ho, S.K. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 20 Aug 1985. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000741.

Alpha particles born at D-T fusion are mirror confined in the tandem mirror due to their relatively high energy. Therefore, they have a loss-cone type distribution in the velocity space. This anisotropy is susceptible to microinstability. The objective of this work is to study the possible instability that can be driven by the alpha loss-cone. The low frequency (at the order of the ion cyclotron frequency) wave spectrum is studied to seek the waves that can be destabilized by the alphas. The radial mode structure is found for the growth rate calculation. The alpha particle distribution with a loss-cone is obtained from a Legendre function expansion and a diffusion front method. The growth rate of the instability is formulated from linear stability theory and computed numerically. A marginal stability boundary in the ion density and temperature parameters is calculated.

1853 **Landau damping: New aspects of an old story.** Heinz, U. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). *Physics Letters [Section] A;* **109**: No. 8, 385-388(17 Jun 1985).

We reinvestigate the dispersion relation for longitudinal plasma waves in a collisionless electron plasma. We show that even at finite temperature there exists a critical wave number kappasub(cr) below which Landau damping is absent. Furthermore, the magnitude of damping deviates from Landau's formula also well above kappasub(cr). We propose to extend existing experiments to wave numbers kappa proportional kappasub(cr).

1854 **High resolution X-ray spectroscopy diagnostics of high temperature plasmas.** Kaellne, E.; Kaellne, J. (JET Joint Undertaking, Abingdon (UK)); Marmar, E.S.; Rice, J.E. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Physica Scripta;* **31**: No. 6, 551-564(Jun 1985).

This paper presents advances in the use of high resolution X-ray spectroscopy for the measurements of tokamak plasmas and the study of atomic processes. The measurements refer to H- and He-like spectra of Ar (lambda = 3.7 to 4.2 A) obtained with a new crystal spectrometer at the Alcator C tokamak. With record count rates of up to 0.5 MHz, time resolved spectroscopy of individual plasma discharge was demonstrated at the 20 ms time scale. In particular, the time evolution of ion and electron temperatures, Tsub(i)(t) and Tsub(e)(t), was determined and occurrences of transient plasma phenomena were recorded in discharges with deuterium pellet injection. X-ray line emission was for the first time observed along different chords through the plasma so as to determine the radial dependence of the principal plasma parameters Tsub(i)(t) and Tsub(e)(r). These radial scan data are shown to be of interest for identifying manifestations of underlying atomic processes and ion transport effects. On the basis of the present results, we assess the future use of X-ray spectroscopy diagnostics to obtain extensive information on the temporal and spatial dependences of the main plasma parameters together with new information on transient phenomena as well as on the neutral content of tokamak plasmas.

1855 **Helical equilibrium with anisotropic pressure and mass flow.** Rizk, H.M. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). *Physica Scripta;* **31**: No. 6, 592-593(Jun 1985).

A helical equilibrium equation with anisotropic pressure and mass flow is derived. A simple helical plasma model for high beta with highly anisotropic pressure (Psub(parallel) >> Psub(perpendicular to)) and small helicity is described. The effect

of mass flow on a β-limitations which appears in this case is studied.

1856 Soft-X-ray tomography on Alcator C. Granetz, R.S.; Camacho, J.F. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Nuclear Fusion;* **25**: No. 6, 727-732(Jun 1985).

Letter-to-the-editor.

Using 80 miniature soft-X-ray detectors viewing along chords through a plasma cross-section at one toroidal location, tomographic reconstructions of emissivity have been obtained without the need for assuming any symmetry or rotation of the plasma. In one class of plasma discharges, it is found that a large m=1 oscillation, which previously had been ascribed to the rotation of an MHD instability, actually is not rotating at all.

1857 Impurity transport in ICRH tokamak plasma. Chan, V.S.; Chiu, S.C.; Wong, S.K. (GA Technologies, Inc., San Diego, CA (USA)). *Nuclear Fusion;* **25**: No. 6, 697-704(Jun 1985).

Energetic ion tails created by ion cyclotron resonance heating can cause inward diffusion of impurities from the tokamak periphery. The inward pinch velocity is proportional to the charge of the impurities and can be comparable to or higher than the neoclassical pinch velocity for the present-day experimental regime. It depends critically on the plasma density and the applied RF power and is moderately dependent on the concentration of the heated ion species and the plasma current.

1858 Giant sawtooth oscillations in the Doublet III tokamak. Pfeiffer, W.; Marcus, F.B.; Armentrout, C.J.; Jahns, G.L.; Petrie, T.W.; Stockdale, R.E. (GA Technologies, Inc., San Diego, CA (USA)). *Nuclear Fusion;* **25**:. No. 6, 655-671(Jun 1985).

Large-amplitude sawtooth oscillations have been observed in the soft-X-ray emission, central electron temperature, neutron production rate, radiated power, Dsub(α) emission, fast-neutral flux and one-turn voltage during beam-heating experiments in the Doublet III tokamak. The necessary conditions for the appearance of giant sawteeth seem to be operation at low qsub(a) and high βsub(T). Many features of the giant sawteeth have been simulated with a transport code to which a sawtooth mixing model and several diagnostic models were added. Substantial redistribution of particles and energy evidently occurs over the plasma interior. Global energy confinement, however, is only moderately degraded by the sawteeth.

1859 Double-sawtooth oscillations in the Doublet III tokamak. Pfeiffer, W. (GA Technologies, Inc., San Diego, CA (USA)). *Nuclear Fusion;* **25**: No. 6, 673-679(Jun 1985).

Sawtooth oscillations with two periods and amplitudes per cycle have been observed by the soft-X-ray diodes on the Doublet III tokamak, most often during beam heating at high current. A theoretical model for such double sawteeth is proposed, in which both disruptions in a cycle are due to magnetic reconnection associated with islands formed about q=1 surfaces (where q is the safety factor). The second reconnection, which causes the larger disruption, encompasses the magnetic axis as in previous models, whereas the first reconnection does not. Numerical transport simulations using the new model give results in qualitative agreement with those observed experimentally and imply that the sawtooth-induced energy transport from double sawteeth is essentially the same as that due to single sawteeth of the same cycle length.

1860 Energy confinement time of tokamak plasma with auxiliary heating. Ohkawa, T. (GA Technologies, Inc., San Diego, CA (USA)). *Comments on Plasma Physics and Controlled Fusion;* **9**: No. 3, 127-138(May 1985).

The formulas for electron thermal diffusivity of tokamak plasmas with various heating methods are derived based on the phenomenological free energy argument. The experimental results appear to support the formula.

1861 Absolute measure of heating by suprathermal electrons in a gas puff Z-pinch. Hares, J.D.; Marrs, R.E.; Fortner, R.J. (Imperial College of Science and Technology, London, England). *Journal of Physics, D (London). Applied Physics;* **18**: No. 4, 627-631(14 Apr 1985).

X-ray spectroscopy of high density (nsub(e) approx.= 10^{21} cm^{-3}) hot spots in an argon gas puff Z-pinch device has shown resolved Kα-like transitions from various ionisation stages. An investigation into hot-spot physics suggests that collisional excitation by runaway electrons drives the inner shell emission. The intensity of the inner transitions provides a measure of the suprathermal electron energy deposition, which is sometimes greater than the energy content of a hot spot. However the authors argue that suprathermal electrons are not a principal heating source for the x-ray hot spots.

1862 Hydrodynamics of compression of a magnetized plasma by a thin cylindrical wall. Velikovich, V.L.; Gol'berg, S.M.; Liberman, M.A. (AN SSSR, Moscow. Inst. Fizicheskikh Problem); Felber, F.S. (JAYCOR, San Diego, CA (USA)). *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki;* **88**: No. 2, 445-460(Feb 1985). (In Russian).

For English translation see the journal Soviet Physics - JETP (USA).

The hydrodynamics is considered of a dense plasma with a magnetic field compressed by a thin cylindrical wall. Self-similar solutions for compression of the plasma by a wall are obtained and the structure of the boundary layer of the plasma near the wall compressing it is found. It is shown that the formation of the boundary layer and the thermal fluxes and thermomagnetic currents which arise lead to an appreciable increase in the diamagnetism of the plasma. The magnetic flux losses due to compression of a plasma with classical transfer coefficients may increase considerably and reach the values for a turbulent plasma. It is shown that at the moderate rate of compression of a plasma by a cylindrical wall which are attainable experimentally, the magnetic flux losses are insignificant and efficient compression of a magnetic field frozen in the plasma by a cylindrical wall should be feasible. Numerical calculations of radial compression of a plasma with a magnetic field by a cylinder are in googd agreement with the self-similar solutions obtained. Numerical simulation of the problem shows that compression of the magnetic field in the scheme under consideration weakly depends on the equation of state of the cylinder walls, its specific heat, conductivity or compressibility.

1863 Hot-ion plasma in the Toroidal Cusp Experiment. Rhodes, M.; Dawson, J.M.; Gao, P.; Luhmann, N.C. Jr.; Ratiff, S.T.; LeBoeuf, J.N. (California Univ., Los Angeles (USA)). pp 419-427 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/I-I-5).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

The paper describes the theoretical background and experimental results of a novel magnetic confinement device called the Toroidal Cusp Experiment (TCX). A 48-pole externally mounted electromagnet provides the cusp-shaped field which acts to restrain electron motion when a toroidal E-field is induced via an iron core transformer. The ions are freely accelerated, carrying essentially all the plasma current (approx. 3-7 kA), and experience direct Ohmic heating. Typical helium plasma parameters are: nsub(e) > or approx. 1 x $10^{14}cm^{-3}$, Tsub(e)=14 eV, Tsub(i)=200 eV with up to a 600 eV tail in the direction of acceleration and a plasma duration of 0.5-1 ms limited by the OH transformer volt-seconds. Operation with hydrogen has yielded somewhat lower parameters due to limitation by charge exchange reactions. The theory section provides a simple argument to explain how the cusp-shaped field provides for preferential ion current. Also, results from a single-particle orbit code show how in toroidal geometry the cusp field acts as a periodic magnetic lens array which provides a focusing force allowing ions to execute constant-radius toroidal orbits. Equilibrium is provided for the ion plasma current without a vertical field. The experimental section details data from hydrogen and helium plasmas, including scalings for applied E-field, B-field, and gas fill pressure.

Observations are discussed in detail, and plans for TCX2, a larger more powerful device now nearing completion, are outlined.

1864 **Summary on magnetic confinement theory.** Callen, J.D. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). pp 473-485 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/K-3).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Also published in Nucl. Fusion v. 25(2), 1985, p. 205.

The paper summarizes the progress in the area of the magnetic confinement theory, as derived from the works of the 10th International Conference on Plasma Phyiscs and Controlled Nuclear Fusion Research (London, 1985).

1865 **Experimental and theoretical investigations of compact toroid configurations with large-orbit particles.** Lovelace, R.V.; Fleischmann, H.H.; Jayakamar, R. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). pp 403-411 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/I-I-3).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Experimental and theoretical progress has been made on toroidal plasma configurations (spheromaks) including an energetic, large-orbit, ion ring component. A particular advantage of the ion ring component is the stabilization of the tilt-shift modes without close-fitting metal walls, and the added flexibility of the possible reactor options of the configuration. The theory has now been developed to the point where definite stability predictions can be made on the percentage of the total current in the ion rings needed for stability as well as the optimum geometry. Experiments on the RECE-Christa device have succeeded in generating stable rings with about equal plasma and large-orbit fast electron currents.

1866 **Dynamical theory of anomalous particle transport.** Meiss, J.D.; Cary, J.R.; Escande, D.F.; MacKay, R.S.; Percival, I.C.; Tennyson, J.L. (Texas Univ., Austin (USA). Inst. for Fusion Studies). pp 441-448 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/I-I-7).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

The quasi-linear theory of transport applies only in a restricted parameter range, which does not necessarily correspond to experimental conditions. Theories are developed which extend transport calculations to the regimes of marginal stochasticity and strong turbulence. Near the stochastic threshold the description of transport involves the leakage through destroyed invariant surfaces, and the dynamical scaling theory is used to obtain a universal form for transport coefficients. In the strong-turbulence regime, there is an adiabatic invariant which is preserved except near separatrices. Breakdown of this invariant leads to a new form for the diffusion coefficient.

1867 **Non-ohmic currents in the Proto-Cleo Stellarator.** Treffert, J.D.; Shobet, J.L. (Torsatron/Stellarator Laboratory, University of Wisconsin-Madison, Madison, Wisconsin). pp 80 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

The Proto-Cleo Stellarator plasma is produced by a washer gun; ohmic heating is not employed. The net electric current as measured by a Rogowski coil is less than 5 amps; however, significant local currents have been measured using saturation current paddle probes. Transient currents 4 A/cm^2 appear 100-300 μsec after injection, in some cases preceded by large 50-70 kHz fluctuations. The currents in the first 300 μsec of the discharge appear to be induced by the tangential (along the separatrix) plasma injection. The toroidal electron current 400 μsec after injection appears to be the superposition of a uni-directional current (1 A/cm^2) and a smaller (100 mA/cm^2) current which changes direction on opposite sides of the magnetic axis. During times of interest, the Proto-Cleo plasma is in the Pfirsch-Schluter collisionality regime. The shape of the bidirectional toroidal electron current profile is consistent with MHD theory and the magnitudes agree to within a factor of 3-4. The scaling of the bidirectional toroidal electron current with main B field and electron pressure is also consistent with MHD theory. The net value of the undirectional toroidal electron current integrated across the plasma cross section and its profile shape are consistent with calculations of the diffusion driven ("bootstrap") current in the Pfirsch-Schluter regime. The scaling of the unidirectional electron current with pressure is also consistent with this MHD theory. The toroidal ion currents are smaller than would be expected from MHD theory estimates but this may be due to the small probe size. Results of local net current measurements using a miniature Rosowski coil will also be presented.

1868 **Soft and hard x-ray spectroscopic radial profile measurements during lower-hybrid current drive and heating experiments on the versator II Tokamak.** Mayberry, M.J.; Chen, K.I.; Knowlton, S.F.; Luckhardt, S.C.; McDermott, F.S.; Porkolab, M.; Rohatgi, R. (Massachusetts Institute of Technology, Cambridge, MA). pp 97 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

Soft and hard x-ray pulse height analysis (PHA) diagnostic systems are being used on Versator II to study electron tail behavior during lower-hybrid (800MHz) current drive and heating. the side, 14″ above, 6″ below). Initial measurements indicate that background x-rays with this arrangement are minimal. Radial scans of the entire plasma cross section (in/out) are accomplished by moving the detector/shield assembly on a track along a major radius of the tokamak. Initial measurements of the hard x-ray spectrum in low density RF target plasmas confirm a large, high energy (up to 500 keV) electron tail. Data are presented on the radial dependence of the soft and hard x-ray spectra both from ohmic plasmas as well as from RF current driven plasmas. Measurements with the Si(Li) detector have also been made during lower-hybrid electron heating in the density range n /sub e/ =1-2 x 10^{13}cm^{-3}. Results so far have shown an enhancement in the electron tail (E > 4keV), but no measureable bulk heating. In all of the experiments described so far, the RF is injected through a side port of the tokamak. In further experiments, soft and hard x-ray profile measurements will be made with the RF injected through a top port.

1869 **Applications of lower hybrid wave current drive: some preliminary observations from the PLT.** Hooke, W.; Bernabei, S.; Chu, T.K.; Hosea, J.; Jobes, F.; Motley, R.; Stevens, J.; Von Goeler, S. (Princeton University). pp 98 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

During the past two years, RF current drive in tokamak plasmas has been demonstrated unambiguously in several laboratories. The interest in these experiments is based on the prospect of using RF current drive to reduce or supplement the induction ohmic heating system, so that the tokamak would become a steady-state device without an enormous and complicated ohmic heating system. To this end the authors have begun studies on: current ramp-up with and without assist from the ohmic heating system, plasma ionization and current start-up with no ohmic heating assist, and resetting the ohmic heating transformer in the presence of RF current drive. They have seen current ramp-up at the rate of 85 kA/second with no ohmic heating drive and 200 kA/second from a

combination of RF and OH drive with each opeating at a level such that unaided by the other system it was unable to ramp-up the plasma current. Operating into a neutral gas with no ohmic heating system 150 kW of RF has produced plasma densities up to 10^{12} cm^{-3} and plasma currents up to 4 kA. Although these numbers are modest, they suggest that lower hybrid is a prime candidate for OH assist in the formation of plasma and the starting-up of plasma currents. Scenarios have been proposed for reactor operation in which a combination of OH and RF current drive systems are used. In these systems the RF drives the current in the face of a negative loop voltage resulting from the resetting of the ohmic heating transformer. An example of RF current drive during transformer resetting is shown.

1870 **Ordinary mode electron cyclotron heating of plasmas in Doublet III.** Prater, R.; Lin, S.H.; Moeller, C. (GA Technologies Inc. San Diego, CA). pp 94 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

ECH experiments have been carried out in the Doublet III tokamak using an outside (low field side) launch of the ordinary mode. Two 60 GHz gyrotrons were used to generate up to 255 kW of power delivered in the ordinary mode polarization to the plasma. Electron heating was seen on the Thomson scattering system, Thomson profile system, soft X-ray pulse height analyzer, and the grating radiometer measuring emission at the second harmonic. For central toroidal fields near the resonance value of 21.4 kG and for line average densities near 2.5×10^{13} cm^{-3}, the Thomson scattering system measured central electron temperature increases of about 600 eV. At densities below 2.0×10^{13} cm^{-3} central electron temperature increases in excess of 1 keV are found. The soft x-ray analysis indicates temperature increases which are 10% to 30% smaller than Thomson scattering temperatures; this discrepancy may be due to the 30 msec integration time of the X-ray system. The one-turn loop voltage drops typically by 40% during the heating due to the increase in plasma conductivity. Charge exchange neutral energy analysis shows ion temperature increases of up to 30%, which is roughly consistent with expected electron-ion energy equipartition rates.

1871 **A multichannel high speed data recorder.** Chang, J.; Black, J.P.; Foesch, J.A.; Jordan, G.; Malone, R.; Manning, J.; Martinez, C.; Ward, M. (Sandia National Laboratories, Albuquerque, New Mexico). pp 110 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

A multichannel high speed data recorder system has been constructed using the state-of-the-art fiber optic, and streak camera technologies. The system is composed of multichannel fiber optic input to a high speed Hamamatsu streak camera. The digital output from the streak camera is directly input to a captive LSI 11/23 based micro-computer for data handling. The system could be configured for multiple functions. These include 1-D imaging, tomography, and multichannel data recording of both analog light and electrical signals. For data recording, a minimum of 43 separated channels with up to 20:1 dynamic range and 35 ps time resolution could put onto a single streak camera. For imaging applications, 200 fiber channels could be input to a streak camera. Schemes for 1-D, 2-D, and tomographic imaging of relativistic electron beams are presented.

1872 **Ideal MHD B limits in the BIG DEE tokamak.** Helton, F.J.; Bernard, L.C.; Greene, J.M. (GA Technologies Inc., San Diego, CA). pp 101 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

Using D-D reactions, tokamak reactors become economically attractive when B (the ratio of volume averaged pressure to magnetic pressure) exceeds 5 percent. Ideal MID instabilities are of great concern because they have the potential to limit B below this range and so extensive studies have been done to determine ideal MHD B limits. As B increases with inverse aspect ratio, elongation and triangularity, the Doublet III upgrade machine – BIG DEE – is particularly suited to study the possibility of very high B. The authors have done computations to determine ideal MHD B limits for various plasma shapes and elongations in BIG DEE. They have determined that for q at the plasma surface greater than 2, B is limited by the ballooning mode if the wall is reasonably close to the plasma surface ($d/a < 1.5$ where d and a are the wall and plasma radii respectively). On the other hand, for q at the plasma surface less than 2, the n=1 external kink is unstable even with a wall close by. Thus, relevant values of limiting B can be obtained by assuming that the external kink limits the value of q at the limiter to a value greater than 2 and that the ballooning modes limit B. Under this assumption, a relevant B limit for the BIG DEE would be over 18%. For such an equilibrium, the wall position necessary to stabilize the n=1 and n=2 modes is 2a and the equilibrium is stable for n=3.

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REFER ALSO TO CITATION(S) 799, 1171

1873 **(CONF-850507—53) Nuclear data needs for fusion reactors.** Gohar, Y. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85018376.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The nuclear design of fusion reactor components (e.g., first wall, blanket, shield, magnet, limiter, divertor, etc.) requires an accurate prediction of the radiation field, the radiation damage parameters, and the activation analysis. The fusion nucleonics for these tasks are reviewed with special attention to point out nuclear data needs and deficiencies which effect the design process. The main areas included in this review are tritium breeding analyses, nuclear heating calculations, radiation damage in reactor components, shield designs, and results of uncertainty analyses as applied to fusion reactor studies. Design choices and reactor parameters that impact the neutronics performance of the blanket are discussed with emphasis on the tritium breeding ratio. Nuclear data required for kerma factors, shielding analysis, and radiation damage are discussed. Improvements in the evaluated data libraries are described to overcome the existing problems.

1874 **(CONF-850708—4) Comparison of tokamak burn cycle options.** Ehst, D.A.; Brooks, J.N.; Cha, Y.; Evans, K. Jr.; Hassanein, A.M.; Kim, S.; Majumdar, S.; Misra, B.; Stevens, H.C. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018393.

From Workshop on tokamak start-up - problems and scenarios related to the transient phases of long-burn operations; Erice, Italy (14 Jul 1985).

Experimental confirmation of noninductive current drive has spawned a number of suggestions as to how this technique can be used to extend the fusion burn period and improve the reactor prospects of tokamaks. Several distinct burn cycles, which employ various combinations of Ohmic and noninductive current generation, are possible, and we will study their relative costs and benefits for both a commerical reactor as well as an INTOR-class device. We begin with a review of the burn cycle options.

1875 **(CONF-850814—10) Three computer codes for safety and stability of large superconducting magnets.** Turner, L.R. (Argonne National Lab., IL (USA)). 1985. Contract AC07-76ID01570;W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018444.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

For analyzing the safety and stability of large superconducting magnets, three computer codes TASS, SHORTURN, and SSICC have been developed, applicable to bath-cooled magnets,

bath-cooled magnets with shorted turns, and magnets with internally cooled conductors respectively. The TASS code is described, and the use of the three codes is reviewed.

1876 **(CONF-850814—19) Quench energies of potted magnets, III.** Dresner, L. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85016962.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

Several different formulas have been proposed for estimating quench energies of potted magnets. These formulas, although based on plausible approximations, disagree with one another by factors of 2 to 6. By the use of maximum and minimum principles for the heat balance equation, it has been possible to determine whether each estimate is an upper or lower bound and to show that some estimates majorize others.

1877 **(CONF-850920—6) Design and preliminary test results of the quench detection system for IFSMTF.** Shen, S.S.; Walstrom, P.L.; Wilson, C.T.; Goddard, J.S. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 4p. NTIS, PC A02. File Number DE86001355.

From 9. international conference on magnet technology; Zurich, Switzerland (9 Sep 1985).

A unique quench detection system was designed for the International Fusion Superconducting Magnet Test Facility (IFSMTF), where a simultaneous test of six large superconducting toroidal field magnets will be carried out. The scheme was based on analog subtraction of self and neighboring pickup winding voltage from the coil voltage to yield a compensated signal proportional to a normal-zone voltage. The compensated signals were input to quench detection modules that give a quench output signal to discharge the coil if the compensated signals exceed preset thresholds for preset time durations. This paper summarizes the design and analysis of the system and presents the experimental results of the simulation tests, two-coil charging-discharging tests, and the normal-zone recovery tests.

1878 **(DOE/DP/40124—35) Irradiation of spherical shell targets with 6 uv OMEGA beams.** Richardson, M.C.; Keck, R.; Yaakobi, B.; Letzring, S.; Delettrez, J.; Verdon, C.; Soures, J.M.; Gregory, G. (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1984. Contract AC08-80DP40124. 16p. (CONF-8405163—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001306.

From Anomalous absorption conference; Charlottesville, VA, USA (6 May 1984).

The availability of a multi-beam uv irradiation facility permits, for the first time, the study of the performance of spherical targets directly driven under collisional absorption in the absence of preheat and smoothing effects produced by superthermal electrons. Six upconverted (351 nm) beams of OMEGA focused by f/3.5, 60 cms focal length optics oriented in an approximately cubic irradiation geometry have been fully characterized and the level of energy deposition uniformity estimated numerically and experimentally. The reaction of targets to specific levels of irradiation uniformity is under study. The implosion characteristics of a variety of targets under the most uniform irradiation conditions are investigated with a number of diagnostics and are compared with the predictions of one- and two-dimensional hydrodynamic codes.

1879 **(DOE/ER—0046/22) Damage analysis and fundamental studies. Quarterly progress report, April-June 1985.** (USDOE Office of Energy Research, Washington, DC. Office of Fusion Energy). Aug 1985. Contract AC06-76FF02170. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001638.

Separate abstracts were prepared for 4 of the included sections. (MOW)

1880 **(DOE/ER/53104—T4) Modeling ambipolar potential formation due to ICRF heating effects on electrons.** Johnson, J.W.; Callen, J.D.; Hershkowitz, N. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Aug 1985. Contract AC02-80ER53104. 24p. (UWPR—85-4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85018047.

A mechanism for the potential bump observed near the region of ICRF heating in the endplugs of the Phaedrus tandem mirror experiment is investigated by numerical simulation of electron orbits in a simple mirror geometry. Given initial magnetic and ambipolar potential wells that trap the electrons, the "near field" parallel electric field E-tilde/sub z/e/sup -iωt/, which is localized near and due to the ICRF heating, tends to eject electrons from the region where E-tilde/sub z/ is nonzero. This depletion of the local electron population causes a local increase in the ambipolar potential. The rate at which the electrons are ejected, (dn/dt), is calculated from the electron orbit computation for a given potential well depth. The rate at which passing particles "fill in" the potential well can also be calculated. An estimate of how large the bump in the ambipolar potential becomes is obtained by finding the well depth at which (dn/dt) approximately equals the "filling" rate. For Phaedrus parameters ($n_0 \approx 4.0 \times 10^{12}$ cm^{-3}, T/sub e/ = 20 eV, E-tilde/sub z/ $\approx$ 1.0 V/cm) the electron pumping rate balances the "filling" rate at a potential well depth of approximately 40 V, consistent with experimental results.

1881 **(DOE/ET/51013—155) MIT 12 Tesla Coil test results.** Steeves, M.M.; Hoenig, M.O. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jul 1985. Contract AC02-78ET51013. 136p. (PFC/RR—85-12). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86001110.

Test results from the MIT 12 Tesla Coil experiment are presented. The coil was tested in the High Field Test Facility (HFTF) of the Lawrence Livermore National Laboratory in October 1984 and January 1985. The experiment measured the performance of an Internally Cooled, Cabled Superconductor (ICCS) of practical size, intended for use in magnetic fusion experiments. The MIT coil carried 15 kA at 11 T for 5 min with no sign of instability. A half turn length in a 10 T field was able to absorb a heat load in 4 msec of more than 200 mJ/cm^3 of cable volume while carrying a current of 12 kA. The MIT coil successfully met the performance requirements of the Department of Energy's 12 Tesla Coil Program.

1882 **(DOE/ET/51013—159) Axisymmetric pumping scheme for the thermal barrier in a tandem mirror.** Li, X.Z. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1985. Contract AC02-78ET51013. 38p. (PFC/RR—85-19). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002001.

An axisymmetric pumping scheme is proposed to pump the particles that trap in a thermal barrier without invoking the neutral beam or geodesic curvature. In this scheme a magnetic scraper is moved uni-directionally on the barrier peak to push the barely trapped particles into the central cell. We utilize a potential jump that forms at the peak field for sufficiently strong pumping. The non-collisional catching effect has to be limited by setting an upper limit on the scraping frequency of the magnetic bump. On the other hand, the dynamic stability of the pumping scheme sets a lower limit on the scraping frequency. Using the variational method, we are able to estimate the window between these two limits, which seems feasible for the Tara reactor parameter set. A primary calculation shows that the magnetic bump, $\Delta B/B$ is about 10^{-4} and the scraping frequency, nu/sub sc/, is about 10^{+3}sec^{-1}, which are similar to the parameters required for those for drift pumping.

1883 **(DOE/ET/51013—T5) Massachusetts Institute of Technology, Plasma Fusion Center, 1984-1985. Report to the President.** (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jul 1985. Contract AC02-78ET51013. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001476.

During the past year, technical progress has been made in all Plasma Fusion Center (PFC) research programs. The Plasma Fusion Center is recognized as one of the leading university research laboratories in the physics and engineering aspects of magnetic confinement fusion. Its research programs have produced significant results on four fronts: (1) the basic physics of high-temperature plasmas (plasma theory, rf heating, free electron lasers, development of advanced diagnostics and small-scale experiments on the Versator tokamak and Constance mirror devices); (2) major con-

finement results on the Alcator C tokamak, including pioneering investigations of the stability, heating, and confinement properties of plasmas at high densities, temperatures and magnetic fields; (3) development of an innovative design for axisymmetric tandem mirrors with inboard thermal barriers, with initial operation of the TARA tandem mirror experiment beginning in 1984; and (4) a broad program of fusion technology and engineering development that addresses problems in several critical subsystem areas (e.g., magnet systems, superconducting materials development, environmental and safety studies, advanced millimeter wave source development, and system studies of fusion reactor design, operation, and technology requirements). A review of these programs is given.

1884 **(DOE/OR/21400—T196) MINIMARS scoping cost assessment. MINIMARS design review.** Hamilton, W.R. (Oak Ridge National Lab., TN (USA)). 17 Sep 1985. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001351.

The viewgraphs from the MINIMARS design review meeting are presented. (MOW)

1885 **(GA-A—18070) Fusion reactor production of ^{60}Co.** Engholm, B.A.; Cheng, E.T.; Schultz, K.R. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1985. Contract AC03-84ER53158. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000827.

This report summarizes the results of a brief study done to assess the supply of and demand for ^{60}Co for irradiation facilities, and of the potential that fusion reactors have to meet the projected demands. We have found that the main demand for ^{60}Co today (~ 11 MCi/y - world, and 5.4 MCi/y - US) is for medical product sterilization and that this demand is met primarily by cobalt pins irradiated in CANDU fission reactors by Atomic Energy of Canada, Limited. This arrangement appears adequate through about 1990 although the potential for supply disruptions due to unexpected reactor outages and the undesirability of a single source of supply are of concern. A shortfall after 1990 is possible, especially if food irradiation generates increased demand. Alternative sources of ^{60}Co and possible substitutes exist but do not appear attractive. Fusion reactors could provide a very effective source of ^{60}Co. Even near term fusion test reactors could produce tens of MCi per year at high specific activity (~ 10-40 Ci/g) with little apparent impact on reactor design or operation if modest availabilities (~ 25% to 50%) can be achieved. A commercial fusion reactor with a blanket optimized for ^{60}Co production could produce hundreds of MCi/y with specific activity up to 200 Ci/g at costs well below the present price of $1/Ci.

1886 **(IAE—3891/7) Physical research program for the T-15 tokamak.** Alikaev, V.V.; Brevnov, N.N.; Britousov, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 43p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85702735.

Major parameters of the large tokamak are presented. Main stages of the experimental program are discussed: investigation of ohmic and auxiliary methods of plasma heating, study of plasma-wall interaction and conducting of engineering-physical researches necessary for construction of the prototype of a thermonuclear reactor. Basic systems of the device and used diagnostics are described. Some physical and technical aspects of plasma behaviour in a tokamak are considered: problems of equilibrium, instabilities, impurities and heating of a plasmas. Expected plasma parameters in the T-15 and other large tokamaks are presented.

1887 **(IAE—3923/8) Study of stressed state of a model of a tokamak toroidal magnet with strong field by means of the polarization-optical method.** Alekseev, Yu.A.; Babich, V.V.; Kisula, V.V.; Korolev, A.I.; Tatarinov, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702741.

The results of polarization-optical investigation on the stressed state of a model toroidal magnet of a tokamak with a strong field and combined adiabatic compression of the plasma filament are reported. The transparent model has been realized similar to the real magnet construction in the 1:6, 7 scale. For obtaining isoclinic fields the model has been manufactured from plexiglass, for recording pictures isochroms - from epoxide resin. The analysis of the investigation results shows that the most loaded region of a magnet is its central part. Maximum equivalent stresses in this region attain G2 kg/mm^2 in steel and 47 kg/mm^2 in bronze.

1888 (INIS-SU—269, pp 63-65) **Hydrogen permeability of palladium after effect of glow discharge plasma.** Glazunov, G.P.; Ternopol, A.M.; Volkov, E.D.; Sagalovich, V.V.; Yuferov, V.B. 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780882.

In Radiation damage physics and radiation technology.

Palladium membranes surfaces treatment by glow-discharge plasma in hydrogen and helium effecting pumping out rate of hydrogen (permeability) has been investigated. Glow discharge parameters: (voltage 800-1200 V, currert density 5-15 MA)cm^2, pressure H_2 10-30 Pa, magnetic field 250 Oe. Temperature of samples is at irradiation 00 K (water cooling), expose time 1200 s, radiation dose 7.57 x 10^{19} particle/cm^2. It is shown that irradiation of non-activated samples leads to substantial (by 60..70%) permeability increase.

1889 **(LA—10500-MS) Compact Reversed-Field Pinch Reactors (CRFPR): fusion-power-core integration study.** Copenhaver, C.; Krakowski, R.A.; Schnurr, N.M.; Miller, R.L.; Bathke, C.G.; Hagenson, R.L.; Mynard, C.R.; Chaffee, A.D.; Cappiello, C.; Davidson, J.W. (Los Alamos National Lab., NM (USA)). Aug 1985. Contract W-7405-ENG-36. 250p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86001238.

Using detailed two-dimensional neutronics studies based on the results of a previous framework study (LA-10200-MS), the fusion-power-core (FPC) integration, maintenance, and radio-activity/afterheat control are examined for the Compact Reversed-Field Pinch Reactor (CRFPR). While maintaining as a base case the nominal 20-MW/m^2 neutron first-wall loading design, CRFPR(20), the cost and technology impact of lower-wall-loading designs are also examined. The additional detail developed as part of this follow-on study also allows the cost estimates to be refined. The cost impact of multiplexing lower-wall-loading FPCs into a ~ 1000-MWe(net) plant is also examined. The CRFPR(20) design remains based on a PbLi-cooled FPC with pressurized-water used as a coolant for first-wall, pumped-limiter, and structural-shield systems. Single-piece FPC maintenance of this steady-state power plant is envisaged and evaluated on the basis of a preliminary layout of the reactor building. This follow-on study also develops the groundwork for assessing the feasibility and impact of impurity/ash control by magnetic divertors as an alternative to previously considered pumped-limiter systems. Lastly, directions for future, more-detailed power-plant designs based on the Reversed-Field Pinch are suggested.

1890 **(LA-UR—85-3163) Microcellular foams via phase separation.** Young, A.T. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 23p. (CONF-851174—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000784.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

A study of wide variety of processes for making plastic foams shows that phase separation processes for polymers from solutions offers the most viable methods for obtaining rigid plastic foams which met the physical requirements for fusion target designs. Four general phase separation methods have been shown to give polymer foams with densities less than 0.1 g/cm^3 and cell sizes of 30μm or less. These methods involve the utilization of non-solvent, chemical or thermal cooling processes to achieve a controlled phase separation wherein either two distinct phases are obtained where the polymer phase is a continuous phase or two bicontinuous phases are obtained where both the polymer and solvent are interpenetrating, continuous, labyrinthine phases. Subsequent removal of the solvent gives the final foam structure.

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1891 **(LA-UR—85-3194) Enhanced heat transfer computations for internally cooled cable superconductor.** Rogers, J.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-851102—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000778.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

Superconducting magnets are built with conductors that are pool bath cooled, internally cooled with the superconductor cabled and contained within a conduit, or conduction cooled. The first two embody superconductors in direct contact with liquid helium. Practical designs of internally cooled cable superconductor (ICCS) are not cryostable. Such superconductors have shown multiple regions of stability and instability. A computational method of adjusting the heat transfer coefficient of a one dimensional system of equations to enhance joule heat removal, primarily in the central region of a pulse heated model of ICCS, has been used to attempt simulation of the multiple stability/instability experiment.

1892 **(NIIEFA-P-B—0635) To calculation of nonlinear magnetic systems with ring coils.** Lamzin, E.A.; Simakov, A.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1984. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85702742.

A finite-difference algorithm for calculation of spatial nonlinear magnetic fields is presented. A modified scalar potential, the approximation of which is exercised on a cylindrical mesh, is used as an intial function. The suggested technique is used for analysis of the tokamak T-15 poloidal field and two spectrometric electromagnets. The calculations are carried out by means of the EhS-1040 computer using the TMI program written in the FORTRAN. Choice of electromagnet geometry from the view point of requirements to the field is substantiated, and distribution of forces affecting the superconducting coil and central core is determined as a result of using technique for calculation of spectrometric electromagnets. Recent data are initial for development of a load-bearing unit of the facility. It is concluded that the developed calculational program permits to simulate the non-ldsinear magnetic fiel with the given accuracy and appropriate time for the medium class computer.

1893 **(ORNL—6111) Fusion Energy Division annual progress report for period ending December 31, 1984.** Morgan, O.B. Jr.; Berry, L.A.; Sheffield, J. (Oak Ridge National Lab., TN (USA)). Jul 1985. Contract AC05-84OR21400. 496p. NTIS, PC A21/MF A01; GPO Dep. File Number DE86001414.

Separate abstracts were prepared for each of the 11 included sections. (MOW)

1894 **(ORNL/M—99) Summary report of ORNL Fusion Energy Division significant accomplishments.** Glowienka, J.C. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001299.

This report contains briefings of 22 studies that have possible technology transfer applications. (MOW)

1895 **(ORNL/TM—9512) JET-ISX-B beryllium limiter experiment safety analysis report and operational safety requirements.** Edmonds, P.H. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001465.

An experiment to evaluate the suitability of beryllium as a limiter material has been completed on the ISX-B tokamak. The experiment consisted of two phases: (1) the initial operation and characterization in the ISX experiment, and a period of continued operation to the specified surface fluence (10^{22} atoms/cm^2) of hydrogen ions; and (2) the disassembly, decontamination, or disposal of the ISX facility. During these two phases of the project, the possibility existed for beryllium and/or beryllium oxide powder to be produced inside the vacuum vessel. Beryllium dust is a highly toxic material, and extensive precautions are required to prevent the release of the beryllium into the experimental work area and to prevent the contamination of personnel working on the device. Details of the health hazards associated with beryllium and the appropriate precautions are presented. Also described in appendixes to this report are the various operational safety requirements for the project.

1896 **(ORNL/TM—9533) Plasma engineering analysis of a small torsatron reactor.** Lacatski, J.T.; Houlberg, W.A.; Uckan, N.A. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 95p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001469.

This study examines the plasma physics and reactor engineering feasibility of a small, medium aspect ratio, high-beta, $l = 2$, D-T torsatron power reactor, based on the magnetic configuration of the Advanced Toroidal Facility, Oak Ridge National Laboratory. Plasma analyses are performed to assess whether confinement in a small, average radius plasma is sufficient to yield an ignited or high-Q driven device. Much of the physics assessment focuses on an evaluation of the radial electric field created by the nonambipolar particle flux. Detailed transport simulations are done with both fixed and self-consistent evolution of the radial electric field. Basic reactor engineering considerations taken into account are neutron wall loading, maximum magnetic field at the helical coils, coil shield thickness, and tritium breeding blanket-shield thickness.

1897 **(ORNL/TM—9550) Migration of a radioactive beryllium in the ISX-B tokamak.** England, A.C.; Hillis, D.L.; Edmonds, P.H. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001448.

One of 12 beryllium tiles on a top rail limiter in the Impurity Study Experiment (ISX-B) tokamak was intentionally made radioactive. The migration of the radioactivity due to melting, ablation, and general excoriation of the radioactive tile was studied. Several hundred milligrams of material from the radioactive tile were spread to the other tiles over the course of the experiment, which consisted of more than 3000 tokamak shots. A small amount of activity was found on the bottom of the tokamak vacuum vessel. The distribution of activity on the other limiter tiles showed a marked radially inward directivity, although all of the tiles received some activity. The possibility that some of the activity was the result of photo- and electro-excitation by runaway electrons cannot be ruled out but probably cannot account for the bulk of the effect.

1898 **(PFC/JA—85-8) Optimization of gyroklystron efficiency.** Tran, T.M.; Danly, B.G.; Kreischer, K.E.; Schutkeker, J.B.; Temkin, R.J. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Feb 1985. Contract AC02-78ET51013. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001609.

The optimization of gyroklystron efficiency is investigated by employing a two-step procedure. As a first step, the prebuncher is analyzed using a small signal approximation, since the cavity(ies) here serve mainly to modulate slightly the velocities of the electrons, which will be bunched in the field-free drift section(s). It is found that the electrons entering the energy extraction cavity can be characterized entirely by only two dimensionless parameters: a bunching parameter q and a relative phase psi. The numerical simulation of the extraction cavity, based on the nonlinear pendulum equations describing the interaction between the electrons and the rf field, supplemented by the initial conditions specified by q and psi, constitutes the second step. The final result of this two-step analysis is the efficiency, eta/sub perpendicular, opt/ optimized with respect to q, psi and the magnetic detuning parameter Δ. This efficiency depends only on the normalized cavity length μ and the normalized rf field F of the energy extraction section. The efficiency as well as the conditions required to attain this optimum (q/sub opt/, Δ/sub opt/, and psi/sub opt/) are presented as contour plots on the (F, μ) plane and can be used efficiently to design gyroklystrons of any frequency and output power.

1899 **(PFC/RR—85-6) Temperature effects on lithium-nitrogen reaction rates.** Ijams, W.J.; Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1985. Contract AP07-79ID00019. 91p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86001848.

A series of experiments have been run with the aim of measuring the reaction rate of lithium and nitrogen over a wide spectrum of lithium pool temperatures. In these experiments, pure nitrogen was blown at a controlled flow rate over a preheated lithium pool. The pool had a surface area of approximately 4 cm^2 and a total volume of approximately 6 cm^3. The system pressure varied from 0 to 4 psig. The reaction rate was very small - approximately 0.002 to 0.003 g Li $min\ cm^2$ for lithium temperatures below 500°C. Above 500°C the reaction rate began to increase sharply, and reached a maximum of approximately 0.80 g Li $min\ cm^2$ above 700°C. It dropped off beyond 1000°C and seemed to approach zero at 1150°C. The maximum reaction rate observed in these forced convection experiments was higher by 60% than those previously observed in experiments where the nitrogen flowed to the reaction site by means of natural convection. During a reaction, a hard nitride layer built up on the surface of the lithium pool - its effect on the reaction rate was observed. The effect of the nitrogen flow rate on the reaction rate was also observed.

1900 **(PPPL—2249) Thermonuclear inverse magnetic pumping power cycle for stellarator reactors.** Ho, D.D.M.; Kulsrud, R.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1985. Contract AC02-76CH03073. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002539.

A novel power cycle for direct conversion of alpha-particle energy into electricity is proposed for an ignited plasma in a stellarator reactor. The plasma column is alternately compressed and expanded in minor radius by periodic variation of the toroidal magnetic field strength. As a result of the way a stellarator is expected to work, the plasma pressure during expansion is greater than the corresponding pressure during compression. Therefore, negative work is done on the plasma during a complete cycle. This work manifests itself as a back-voltage in the toroidal field coils, and direct electrical energy is obtained from this voltage. For a typical reactor, the average power obtained from this cycle (with a minor radius compression factor on the order of 50%) can be as much as 50% of the electrical power obtained from the thermonuclear neutrons without compressing the plasma. Thus, if it is feasible to vary the toroidal field strength, the power cycle provides an alternative scheme of energy conversion for a deuterium-tritium fueled reactor. The cycle may become an important method of energy conversion for advanced neutron-lean fueled reactors. By operating two or more reactors in tandem, the cycle can be made self-sustaining.

1901 **(RAND/WN—10421-DOE) Soviet laser-fusion research organizations: a preliminary outline.** Kassel, S.; Wells, N.; Campbell, C.; Cote, M. (RAND Corp., Santa Monica, CA (USA)). Feb 1979. Contract AC03-78DP40049. 188p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86001875.

The present report constitutes the first stage of the Soviet Laser Fusion project intended to develop a comprehensive picture of Soviet laser fusion research in its organizational and substantive aspects. The aim of the first stage has been the collection of organizational data on Soviet research in this area and the initial identification of specific research teams, leadership structure, institutions and objectives, and their changes in time.

1902 **(UCRL—15718) Design and fabrication of the MFTF-B magnet system.** Tatro, R.E.; Kozman, T.A. (General Dynamics Corp., San Diego, CA (USA). Space Systems Div.; Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000742.

The MFTF-B superconducting magnet system consists of 40 NbTi magnets and two Nb_3Sn magnets. General Dynamics (GD) designed all magnets except for the small trim coils. GD then fabricated 20 NbTi magnets, while LLNL fabricated 20 NbTi magnets and two Nb_3Sn magnets. The design phase was completed in February 1984 and included the competitive procurement of magnet structural fabrication, superconductor, G-10CR insulation, support struts and bearings, vapor-cooled leads, and thermal shields for all magnets. Fabrication of all magnets was completed in March 1985. At GD, dual assembly lines were necessary during fabrication in order to meet the aggressive LLNL schedule. The entire magnet system has been installed and aligned at LLNL, and Tech Demo tests will be performed during September-November 1985.

1903 **(UCRL—89700) Broad-band soft x-ray diagnostic instruments at the LLNL Novette laser facility.** Tirsell, K.G.; Lee, P.H.Y.; Nilson, D.G.; Medecki, H. (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1983. Contract W-7405-ENG-48. 45p. (CONF-8309208—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000738.

From 16. European conference on laser interaction with matter; London, UK (26 Sep 1983).

Complementary broad-band instruments have been developed to measure time dependent, absolute soft x-ray spectra at the Lawrence Livermore National Laboratory (LLNL) Nd glass laser irradiation facilities. Absolute flux measurements of x rays emitted from laser-produced plasmas are important for understanding laser absorption and energy transport. We will describe two new 10-channel XRD systems that have been installed at the LLNL Novette facility for use in the 0.15- to 1.5-keV range. Since XRD channel time response is limited by available oscilloscope performance to 120 ps, a soft x-ray streak camera has been developed for better time resolution (20 ps) and greater dynamic range ($\sim 10^3$) in the same x-ray energy region. Using suitable filters, grazing incidence mirrors, and a gold or cesium-iodide transmission cathode, this streak camera instrument has been installed at Novette to provide one broad and four relatively narrow channels. It can also be used in a single channel, spatially discriminating mode by means of pinhole imaging. The complementary nature of these instruments has been enhanced by locating them in close proximity and matching their channel energy responses. As an example of the use of these instruments, we present results from Novette $2\omega(0.53\ \mu m)$ gold disk irradiations at 1 ns and 10^{14} to 10^{15} W/cm^2.

1904 **(UCRL—91577) Magnetic systems for fusion devices.** Henning, C.D. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 15p. (CONF-850809—82). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000743.

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Mirror experiments have led the way in applying superconductivity to fusion research because of unique requirements for high and steady magnetic fields. The first significant applications were Baseball II at LLNL and IMP at ORNL. More recently, the MFTF-B yin-yang coil was successfully tested and the entire tandem configuration is nearing completion. Tokamak magnets have also enjoyed recent success with the large coil project tests at ORNL, preceded by single coil tests in Japan and Germany. In the USSR, the T-7 Tokamak has been operational for many years and the T-15 Tokamak is under construction, with the TF coils nearing completion. Also the Tore Supra is being built in France.

1905 **(UCRL—92882) Austenitic stainless steels for cryogenic service.** Dalder, E.N.C.; Juhas, M.C. (Lawrence Livermore National Lab., CA (USA)). 19 Sep 1985. Contract W-7405-ENG-48. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86001304.

Presently available information on austenitic Fe-Cr-Ni stainless steel plate, welds, and castings for service below 77 K are reviewed with the intent (1) of developing systematic relationships between mechanical properties, composition, microstructure, and processing, and (2) of assessing the adequacy of these data bases in the design, fabrication, and operation of engineering systems at 4 K.

1906 **Synergistic effects in fusion machines: session summary.** Langley, R.A. (Oak Ridge National Lab., TN (USA)); Manos, D. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Roth, J. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). *Radiation Effects;* **89**: No. 1-2, 5-11(Jun 1985). (CONF-840534—). Contract AC05-84OR21400.

From Workshop on synergistic effects in surface phenomena related to plasma-wall interactions; Nagoya, Japan (21 May 1984).

This summary covers: definition of synergism; areas in which synergism effects might be expected; evidence for enhanced erosion on a graphite probe cap during RF heating of the Princeton Large Torus; erosion of graphite in the ASDEX divertor and simultaneous deposition of impurities both with and without neutral beam injection heating.

1907 **Plasma surface interaction processes and possible synergisms.** Behrisch, R. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Roberto, J.B. (Oak Ridge National Lab., TN (USA)). *Radiation Effects;* **89**: No. 1-2, 13-14(Jun 1985). (CONF-840534—). Contract AC05-84OR21400.

From Workshop on synergistic effects in surface phenomena related to plasma-wall interactions; Nagoya, Japan (21 May 1984).

Plasma-wall interactions are discussed. The term synergism is used in fusion research to describe wall phenomena where the combined effect of independent processes is significantly different from the individual effects considered separately. Examples are listed.

1908 **Steady state hydrogen transport in solids.** Doyle, B.L.; Brice, D.K. (Sandia National Labs., Albuquerque, NM (USA)). *Radiation Effects;* **89**: No. 1-2, 21-48(Jun 1985). (CONF-840534—). Contract AC04-76DP00789.

From Workshop on synergistic effects in surface phenomena related to plasma-wall interactions; Nagoya, Japan (21 May 1984).

The analytical formalism for evaluating the steady state hydrogen (tritium) inventory, recycle and permeation rate and recycle time for surfaces exposed to the plasma of an operating magnetic confinement fusion reactor is reviewed and new material relevant to the application of this theory is presented. The formalism includes hydrogen trapping, diffusion, and effects of thermal gradients (e.g. Ludwig-Soret effect), and is applicable for all orders of release kinetics at the inner and outer surfaces. The problem is formulated in terms of a unitless transport parameter, W = (Rphi/D)(k_1/phi) sup(1/r), where r is the order of the release kinetics, R is the range of the implant, phi is the penetrating part of the incident flux, k_1 is the recombination coefficient and D is the diffusion coefficient. The steady state analytical theory is applied to several materials of interest to controlled fusion.

1909 **Effects of monolayer coverages on substrate sputtering yields.** Gruen, D.M.; Krauss, A.R.; Pellin, M.J. (Argonne National Lab., IL (USA)). *Radiation Effects;* **89**: No. 1-2, 113-127(Jun 1985). (CONF-840534—).

From Workshop on synergistic effects in surface phenomena related to plasma-wall interactions; Nagoya, Japan (21 May 1984).

Materials currently being used or considered for plasma-side applications are not entirely satisfactory, particularly in the medium edge temperature (approx. 100 to 300 eV) regime. A new approach to impurity control based on self-sustaining surface segregated low-Z layers with high secondary ion fractions has been suggested and tested in laboratory experiments. A crucial requirement is that substrate sputtering yields be reduced about an order of magnitude by monolayer adsorbate coverages. Theoretical and experimental evidence is adduced to support the contention that overlayer coverages (a monolayer of Li on Cu) result in profound reductions of substrate (e.g. (Cu) sputtering yields). The conclusion that a material such as a dilute alloy of Li in Cu could function as a limiter or a divertor plate material is, in part, based on the fact that more than 85% of the sputtered flux originates in the first atomic layer (e.g. Li) of the target.

1910 **Synergistic sputtering properties of binary alloys.** Krauss, A.R.; Gruen, D.M.; Lam, N.Q. (Argonne National Lab., IL (USA)); DeWald. A.B. (Georgia Inst. of Tech., Atlanta (USA)). *Radiation Effects;* **89**: No. 1-2, 129-148(Jun 1985). (CONF-840534—).

From Workshop on synergistic effects in surface phenomena related to plasma-wall interactions; Nagoya, Japan (21 May 1984).

We have found that dilute concentrations of lithium in copper produce surfaces which are nearly pure lithium when heated and subject to irradiation. In order to better understand the experimental results, we have modeled the Cu-Li system using a modified version of the TRIM computer code and an alloy segregation program developed by N.Q. Lam. The TRIM code calculates the sputtering yield and depth of origin of the sputtered atoms for materials in which the composition varies from one atomic layer to the next and the segregation program uses these sputtering yields to trace the evolution of the concentration profile. The initial result of sputtering is to preferentially deplete the surface species. Continued irradiation, however, creates a subsurface region of high displacement damage. In the Cu-Li alloy, lithium moves very rapidly through this region, resulting in subsurface lithium enrichment. The enriched region broadens and eventually reaches the surface. The exact effect on the lithium concentration in the first two atomic layers depends on the temperature, damage profile, and particle flux. Results of the calculation are presented, along with a discussion of their implications for fusion reactor materials.

1911 **Design of heliac vacuum magnetic fields.** Shestakov, A.I.; Mirin, A.A. (National Magnetic Fusion Energy Computer Center, Lawrence Livermore National Lab., CA (USA)). *Nuclear Fusion;* **25**: No. 6, 681-696(Jun 1985).

The design of vacuum magnetic fields for helical axis stellarators (HELIACS) is investigated. The aim is to produce realistic configurations possessing magnetic wells (for stability), favourable transform with low shear (to avoid resonant rational surfaces), and small variation of $Q = \int dl/B$ (to minimize parallel currents). An asymmetric toroidal domain whose boundary is assumed to be an outer magnetic surface is created by helically winding a poloidal cross-section about a circle. The magnetic scalar potential inside the domain is computed numerically and field-line integrations are performed in order to evaluate the field properties. The magnetic field is generated by skin currents flowing along the equipotential contours on the boundary. These currents are then discretized into a modular coil system, whose resulting magnetic field is compared with that of the corresponding continuum. Skin current configurations having a shallow well and favourable beta limitations and Q-variation are presented. Discretization of the skin current usually results in a magnetic field which preserves the transform and Q-variation, but with less favourable well properties.

1912 **Energy spectra from 'beam-target' nuclear reactions in magnetic fusion devices.** Heidbrink, W.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **236**: No. 2, 380-384(15 May 1985).

Analytical expressions for the energy distribution of fusion products created in 'beam-target' fusion reactions in a strong magnetic field are derived.

1913 **Magnetic helicity: what is it and what is it good for.** Finn, J.M.; Antonsen, T.M. Jr. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). *Comments on Plasma Physics and Controlled Fusion;* **9**: No. 3, 111-126(May 1985).

A general gauge invariant definition of helicity in a closed volume is presented and compared with other, more restricted definitions. Examples are shown for four geometries of interest to the fusion program. Speculations on the significance of helicity to low frequency current drive schemes are presented.

1914 **Performance of large-aperture KrF lasers for fusion.** Rosenberg, C.W. von Jr.; Klimek, D.E. (Avco-Everett Research Lab., Inc., Everett, MA (USA)); Jacob, J. (Science Research Corp., Cambridge, MA (USA)). pp 177-183 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/B-III-10).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Calculations have been done to characterize the performance of large-aperture (larger than 1mx1m), high energy (25 to 50 kJ) e-beam pumped KrF amplifiers suitable for use in inertial confinement fusion systems. A kinetics code was used to determine optimum pressure, gas composition and pump power for efficient operation. Large-aperture amplifier codes were then used to calculate the intrinsic efficiency of the system as a function of pumped volume dimensions and input flux. These calculations included the effects of amplified spontaneous emission and non-useful coherent flux, originating from reflections off the amplifier window.

1915 **Tokamak Fusion Core Experiment studies.** Schmidt, J.A.; Sheffield, G.V.; Bushnell, C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). pp 297-307 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/H-I-3).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

The basic objective of the next major step in the US fusion programme has been defined as the achievement of ignition and long pulse equilibrium burn of a fusion plasma in the Tokamak Fusion Core Experiment (TFCX) device. Preconceptual design studies have seen completion of four candidate versions to provide the comparative information needed to narrow down the range of TFCX options before proceeding to the conceptual design phase. All four designs share the same objective and conform to common physics, engineering and costing criteria. The four base options considered differed mainly in the toroidal field coil design, two employing superconducting coils and the other two copper coils. In each case (copper and superconducting), one relatively conventional version was carried as well as a version employing more exotic toroidal field coil design assumptions. Sizes range from R=2.6 m for the smaller of the two copper versions to R=4.08 m for the larger superconducting option. In all cases, the plasma current was about 10 MA and the toroidal field about 4 T.

1916 **Compact tokamak hybrid reactor systems.** Perkins, R.G.; Blau, M.; Bussard, R.W. (International Fusion Energy Systems Co. Inc., La Jolla, CA (USA)). pp 309-317 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/H-I-4).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Analyses are presented of hybrid reactor systems which utilize compact high-field tokamak fusion power cores and conventional LMFBR blanket technology. The systems have subcritical external blankets possessing inherent safety advantages relative to a comparable fast reactor. High in situ fuel enrichment in the fast-fission blanket lattice enables natural uranium fresh fuel reloads in a once-through equilibrium fuel cycle. A high-field tokamak experiment designed to demonstrate ignition and equilibrium burn, which utilizes water-cooled high strength CuBeNi magnets, is described.

1917 **Summary of the Mirror Advanced Reactor Study (MARS).** Logan, B.G.; Henning, C.D.; Carlson, G.A. (Lawrence Livermore National Lab., CA (USA)). pp 335-344 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/H-II-1). Contract W-7405-ENG-48.

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

The Mirror Advanced Reactor Study (MARS) is a conceptual design of a 1200 MW(e) commercial tandem mirror reactor for electricity and synfuels (methanol) production. Thermal barrier end plugs of the TMX-U/MFTF-B type allow steady-state ignition of a 130 m long central cell DT plasma. Compact gridless direct converters supply all the plant auxiliary power. The simple lead-lithium eutectic-cooled blanket has high neutron energy multiplication (1.36) as well as a low tritium inventory (<8 g), and it will not melt in accidents.

1918 **Reversed-field pinch: a compact approach to fusion power.** Hagenson, R.L.; Krakowski, R.A.; Bathke, C.G.; Miller, R.L. (Los Alamos National Lab., NM (USA)). pp 373-381 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/H-II-5).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

The potential of the reversed-field pinch (RFP) for development into an efficient, compact, copper-coil fusion reactor has been quantified by comprehensive parametric tradeoff studies. This compact system promises to be competitive in size, power density, and cost to alternative energy sources. Conceptual engineering designs that substantiate these promising results have been completed. This 1000 MW(e) (net) design is described along with a detailed rationale and physics/technology assessment for the compact approach to fusion. The RFP presents a robust plasma confinement system capable of providing a range of reactor systems that are compact in both physical size and/or net power output while ensuring acceptable cost and engineering feasibility for a range of assumed physics performance.

1919 **Progress in inertial confinement fusion at Lawrence Livermore National Laboratory.** Holzrichter, J.F. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). pp 17-24 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/B-I-2).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

The Inertial Fusion Program at Lawrence Livermore National Laboratory has two goals: to study matter under extreme conditions of temperature and pressure and to produce fusion energy from inertially confined fusion fuel. The conclusion of recent multi-kJ, 0.53 μm and 0.26 μm experiments on Novette has demonstrated vastly improved plasma conditions over those previously obtained at LLNL with similar energies at 1.06 μm and elsewhere with 10 μm radiation. The lower preheat environment obtainable with short wavelength light has led to 3 X improvements in the compression of targets on Novette compared to similar targets on Shiva with 1.06 μm. Subsequent experiments on Nova with short wavelength light begin in 1985. They are expected to demonstrate the necessary compression conditions required for high-gain fusion to occur when irradiated with a multi-MJ driver. These recent results, together with improved calculations and innovations in driver and reactor technology, indicate that high-gain inertial fusion will occur and is a viable candidate for fusion power production in the future.

1920 **Short wavelength, direct drive laser fusion experiments at the Laboratory for Laser Energetics.** McCrory, R.L.; Barnouin, O.; Craxton, R.S. (Rochester Univ., NY (USA). Lab. for Laser Energetics). pp 37-47 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/B-I-4).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Measurements are reported of absorption, hot electron generation, preheat, thermal transport and irradiation uniformity in direct-drive, spherical target experiments conducted with six 351 nm wavelength beams of the OMEGA symmetric irradiation facility. On-target energy in excess of 400 J, pulses of 650 ps duration and uniform irradiation at an intensity in the range of (10^{13}-10^{15})W/cm^2 characterize the laser conditions for these experiments. Absorption varied from 100% for Ti targets at an intensity of 10^{13}W/cm^2 to 60% at an intensity of 2 x 10^{15}W/cm^2. The superth-

ermal electron fraction was found to be less than 3 x 10^{-3} of the absorbed energy in these experiments. Higher ablation pressures were measured than in comparable 1054 nm experiments. At a laser intensity of 10^{15}W/cm^2 an ablation pressure of 100 Mbar was deduced from plasma blow-off measurements. Measurement and calculation of the irradiation uniformity indicate that the 24-beam, 351 nm laser OMEGA should be capable of producing the required drive uniformity to compress targets to 200 times liquid DT density with less than 2000 J of laser energy.

1921 **Light-ion fusion research in the USA.** VanDevender, J.P.; Bloomquist, D.D.; Crow, J.T. (Sandia National Labs., Albuquerque, NM (USA)). pp 59-69 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/B-II-1).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Power concentration has been the principal concern for inertial confinement fusion with light-ion beams. Recently a proof-of-principle experiment on ion focusing has been completed on Proto I and indicates that the Particle Beam Fusion Accelerator II (PBFA-II) beam should be focusable for high intensity targets to study ignition. The results are now being scaled to PBFA I. The theoretical stability of the electron sheath in the diode has been examined, and the growth rates are typically 5% of the electron cyclotron frequency. A new spectroscopic diagnostic has been developed to measure the electric fields and ion velocity distributions in the diode. Recent experiments with glow-discharge cleaning have shown that the ion species can be controlled and that the purity can be improved substantially. Plasma erosion opening switches will compress the power pulse to match the target acceptance time on PBFA II. Experiments with these switches on single-module accelerators show power gain. Currents of 5 MA have been interrupted in 20 ns in other experiments. The high voltage lithium ion option has been chosen for PBFA II, and the Applied-B diode has been selected as the first diode for the first shot on PBFA II in January 1986.

1922 **Heavy-ion fusion accelerator research in the USA.** Bangerter, R.O. (Los Alamos National Lab., NM (USA)); Godlove, T.D. (Department of Energy, Washington, DC (USA)); Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, CA (USA)); Keefe, D. (Lawrence Berkeley Lab., CA (USA)). pp 81-89 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/B-II-3).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

In October 1983, a Heavy-Ion Fusion Accelerator Research programme (HIFAR) was established under the Office of Energy Research of the United States Department of Energy. The programme goal over the next several years is to establish a data base in accelerator physics and technology that can allow the potential of heavy ion fusion to be accurately assessed. Three new developments have taken place in the HIFAR programme. First, a decision has been made to concentrate the experimental programme on the development of multiple-beam induction linacs. Second, new beam transport experiments over a large number of quadrupole elements show that stable beam propagation occurs for significantly higher beam currents than had been believed possible a few years ago. Third, design calculations now show that a test accelerator of modest size and cost can come within a factor of three of testing almost all of the physics and technical issues appropriate to a power plant driver.

1923 **Magnetic fields and thermal flux inhibition in inertial confinement fusion.** Emery, M.H.; Gardner, J.H.; Boris, J.P. (Naval Research Lab., Washington, DC (USA)). pp 129-137 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/B-III-3).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Of critical concern in directly driven laser fusion systems is the understanding of electron thermal transport between the region where laser light is absorbed and the ablation layer where the high pressures which accelerate the imploding shell are generated. Evidence has accumulated over the past several years which indicates that the heat flow may be strongly inhibited. Computer hydrodynamics models used to interpret experimental results have typically employed, in an ad hoc fashion, strong flux-limited diffusion which has led to fairly widespread acceptance of a flux inhibition value near f=0.03. It is shown in this paper that the observed flux inhibition can stem directly from the strong magnetic fields generated at the ablation layer as a result of modest laser asymmetries. These fields are shed from the ablation layer and fill the overdense region which strongly influences the thermal transport. The self-consistent numerical simulation of thermal transport in this environment shows strong thermal flux inhibition as interpreted from the following computational measurements: (1) reduced ablation pressures, (2) reduced implosion velocities, (3) reduced mass ablation rates, (4) density profile flattening, and (5) reduced classical absorption; all of which have been experimentally observed. The mass ablation rates obtained from the self-consistent two-dimensional model agree well with a one-dimensional model using an imposed flux inhibition factor of 0.03.

1924 **Symmetry, stability and efficiency in direct-drive laser fusion.** Bodner, S.; Emery, M.; Gardner, J. (Naval Research Lab., Washington, DC (USA)). pp 155-161 of Plasma physics and controlled nuclear fusion research 1984. Proceedings of the tenth international conference on plasma physics and controlled nuclear fusion research held by the IAEA in London, 12-19 September 1984. Vienna, Austria; IAEA (1985). (CONF-840910—Vol.3; IAEA-CN—44/B-III-6).

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

There have been three recent conceptual breakthroughs in the NRL direct-drive laser fusion programme. These substantially enhance the prospects for eventually achieving high pellet gains. First, the authors have invented and developed a technique that produces highly uniform illumination on a pellet, starting with realistic laser beam quality. This allows them to reduce their reliance upon smoothing from sideways energy transport, and thus to use shorter-wavelength lasers. Second, with short-wavelength lasers, their simulations predict a Rayleigh-Taylor growth rate of about 30% of the classical $\sqrt{kg}$ value for the most dangerous mode. This enables them to consider the use of thinner pellet shells. Third, their hydrodynamic code shows that with a short laser wavelength (0.25 μm) and a thin-pellet shell (Rsub(omicron)/ΔRsub(omicron) approx.= 10), there is a high rocket implosion efficiency (15%), with a high overall absorption efficiency (approx.= 70%). This high net efficiency offers the potential for high pellet gains (200-300) using a few-megajoule, broad-band laser driver such as KrF.

1925 **Comparison of experimental spheromak equilibria with Taylor relaxation.** Chin-Fatt, C.; DeSilva, A.W.; Goldenbaum, G.C.; Hart, G.W.; Shaw, R.S.; Tan, B.C. (University of Maryland, College Park, Maryland). pp 122 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

Spatially resolved measurements of the magnetic field in the PS spheromak have been analyzed and compared with the Taylor relaxation model. In the PS series of experiments gross m=1 MHD

instabilities have been stopped by utilizing passive, external stabilization coils. During the resistive decay the plasma appears to pass through a succession of equilibrium states in a time scale consistant with a classical resistivity. The Taylor model assumes k is a constant in space. First the authors compared measured magnetic profiles with predicted profiles and found reasonable agreement. Secondly they computed the ratio of W/K (where W is the magnetic energy inside the separatrix and K is the magnetic helicity) and found an eigenvalue k consistent with the dimensions of the separatrix. Thirdly they computed $k' = J/B$ and found a spatial variation of k'. In particular, k' appears to be constant on a flux surface and is a maximum on the magnetic axis. In addition, the authors find non-zero values of J_1. Finally, they compare the measured values of J/B with those expected from an equilibrium model with pressure due to Morikawa.

1926 **Small toroidal field experiments in RECE-Christa.** Parker, M.R.; Fleischmann, H.H.; Hopman, H.; Taggart, D.P. (Cornell University, Ithaca, New York). pp 122 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

Earlier experiments in the RECE-Christa device gave first indications of the expected MHD stability, in particular tilt stability, of "mixed-CT" configurations in which ring currents are carried by large orbit fast electrons as well as the cold plasma. Such rings were produced by inducing plasma currents in field-reversing electron rings using an on-axis transformer coil. Both currents are in the range of 5-10 kA. In order to investigate the transition to true "mixed-CT" configurations without axial current, the ring experiments are presently being extended to smaller values of the toroidal field $B\theta$. Two parallel approaches are used: The toroidal field is crowbarred at peak, and during the slow (about5 msec) crowbar decay, a 2.5 MeV, 40 kA electron beam is injected and a ring is trapped. Using a steady gas fill, stable electron rings were obtained. Ring trapping in a puffed gas cloud proved more difficult; however, at $B\theta/Bz = 0.5$, rings were obtained which decayed smoothly over 250 μsec, consistent with collisional decay. The toroidal field is crowbarred late in time after it has started to swing back towards zero. Rings are trapped while the toroidal field is peaking and stably translated about 15 ring radii into a region of low density gas, as in normal operation. Then the toroidal field is allowed to swing down to 20-90% of its initial value before being crowbarred. While the toroidal field is decreasing, an on-axis transformer coil is pulsed in order to induce plasma currents in the ring. In this case, toroidal flux in the ring plasma can be maintained during the transition to low external toroidal fields. Preliminary observations do not find the losses earlier observed by Meger.

99 GENERAL AND MISCELLANEOUS

1927 **(DOE/ER—0251) Federal Arctic Research: detailed listing of existing US programs. Initial compilation.** (Interagency Arctic Research Policy Committee, Washington, DC (USA)). Sep 1985. 134p. NTIS, PC A07/MF A01; GPO Dep. File Number DE86001222.

This detailed listing of Federal Arctic Research Programs has been compiled by the Interagency Arctic Research Policy Committee in compliance with Section 109(b)(3) of the Arctic Research and Policy Act of 1984(P.L. 98-373). Included in the listing are brief descriptions of each entry, funds currently being expended, and future funding projections. This listing represents agency plans to the extent that they have been formulated as of July 1985.

9901 Management

1928 **(ANL/TM—431) Electronic mail at ANL.** Finkel, B.; Andre, M.; Janoski, K. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 157p. NTIS, PC A08/MF A01; GPO Dep. File Number DE86002029.

Concepts, issues, and commands basic to electronic mail are discussed and the capabilities and limitations of the electronic mail systems currently in place at Argonne National Laboratory is described, with an emphasis on communication through the Bitnet network. The primary purpose of this document is to complement the detailed information found in vendor documents on electronic mail. You can find the details and procedures of specific electronic mail systems in the appropriate manuals listed in the Bibliography.

1929 **(DOE/MA—0195) Cost and Schedule Control Systems Criteria for contract performance measurement. Summary description.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). Oct 1985. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002080.

This document provides an overview of the DOE CSCSC approach for contract performance measurement. It has been prepared to assist both DOE and contractor personnel in understanding and using the CSCSC approach properly.

1930 **(ORAU—246) University-based continuing education in the Department of Energy contractor system.** Weseman, M.; Orth, M.N.; Doggette, J.R. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1985. Contract AC05-76OR00033. 68p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86002638.

Almost all of the US Department of Energy (DOE) contractors have educational assistance programs which support employee-initiated continuing education. The effectiveness of such programs in meeting continuing education needs, however, is limited by the availability and accessibility of appropriate academic programs. Little systemwide knowledge exists of how DOE contractors have worked with colleges and universities to develop programs specially designed to meet employees' continuing education needs when the desired programs do not exist locally, or are not offered outside normal working hours. This study identifies, describes, and analyzes arrangements between DOE contractors and universities to provide specialized programs in support of the job-related education of scientific, engineering, and other technical personnel. Seven DOE/university programs representing different types of collaborative arrangements are examined in depth. The study identifies a number of factors or program elements which are believed to be related to program effectiveness. The study also analyzes the evolution and current trends in the management and curricula of the DOE/university programs and identifies possible future directions.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 1151, 1256, 1494, 1928, 1945

1931 **(AD-A—156284/2/XAB) Evaluation of a computer based medical diagnostic/information system for nuclear submarines.** Ryack, B.L.; Henderson, J.V.; Moeller, G.O.; Robinson, K.; Post, R. (Naval Submarine Medical Center, Groton, CT (USA). Submarine Medical Research Lab.). Nov 1979. 19p. NTIS, PC A02/MF A01.

From 107. annual meeting of the American Public Health Association; New York, NY, USA (4-8 Nov 1979).

A computer-based medical diagnostic/information system (MEDIC) which will assist the corpsman in diagnosis and treatment of illness is being evaluated at Navy Hospitals and aboard submarines. The system, an adaptation of one developed by de-Dombal for use by physicians at the University of Leeds, England, has been successful in the diagnosis of abdominal pain. The diagnostic program, based upon a Bayesian algorithm, uses only information obtained from patient history and physical examination. Corpsmen are given special training in the collection of this data. The evaluation compares the accuracy of the diagnostic information system, when used by trained corpsmen, with the unaided diagnoses of Navy emergency room corpsmen and physicians. Use of this system can significantly reduce risk to the patient as well as unnecessary and costly medical evacuation. An expanded version will provide diagnosis, treatment guides and prognosis.

1932 (BDX—613-3366) Solid modeling and IGES. Christensen, N.C. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Sep 1985. Contract AC04-76DP00613. 4p. (CONF-8510171—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000528.

From Solid modeling '85: making CAD/CAM pay back; San Francisco, CA, USA (6 Oct 1985).

The current status of IGES as concerns solid modeling is described. Covered are the activities of the IGES Solids Committee, planned solids capability for IGES and IGES-PDES by December 1986. One of the key requirements of CIM is data integration. Data are entered once and then made available to all applications. IGES was developed to allow communication of CAD data between different vendor's systems. Originally the requirement was to communicate drawings. IGES Version 3.0 due in October 1985 contains no capability to communicate solids. But as industry moves toward the use of solids, the IGES Committee has been preparing to meet the foreseen need for solids.

1933 (BDX—613-3374) IGES translator analysis for Autofact '85. Bradford, J. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Oct 1985. Contract AC04-76DP00613. 36p. (CONF-851164—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001296.

From CASA/SME autofact '85; Detroit, MI, USA (4 Nov 1985).

At previous Autofact Conferences there have been floor demonstrations of the Initial Graphic Exchange Specification (IGES) translators. This year, each vendor was invited to process a "seed" file and return the results for evaluation prior to the show. This pre-show approach was taken to provide an expert summary in a timely fashion. Automated evaluation techniques were used, where possible, to provide an impartial and in-depth analysis of vendor translator results. The "seed" file is a drawing with four views of a three-dimensional turned part. inclusion of surface entities makes this part more complex than the Autofact 6 part.

1934 (DOE/ER/13147—2) Perturbation and characterization of nonlinear processes. Progress report, November 15, 1984-November 14, 1985. Swinney, H.L.; Swift, J. (Texas Univ., Austin (USA). Dept. of Physics). 1985. Contract AS05-84ER13147. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001952.

Methods of characterizing nonperiodic processes in nonlinear systems are being developed and tested on low dimensional mathematical models and applied to laboratory data for nonequilibrium systems, particularly the Belousov--Zhabotinskii (BZ) reaction. Methods developed for characterizing dynamical behavior are described first, followed by a discussion of the experimental work.

1935 (KFK—3824) Methods of fault tree analysis and their limits. Weber, G.G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik). Dec 1984. 69p. (CONF-8409255—1). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752209.

From Residential conference on reliability aspects: from devices to systems; Egham, UK (11 Sep 1984).

Some recent methodological developments of fault tree anlaysis are discussed and limits of fault tree analysis and a criterion for admissibility of structure functions are given. It is shown that there are interesting relations to switching theory and to stochastic processes.

1936 (LA-UR—85-3129) Performance programming with the Los Alamos macro accelerator. Cort, G. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 23p. (CONF-8509179—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000788.

From 4. semi-annual meeting of the softool user's group; Santa Barbara, CA, USA (30 Sep 1985).

The CCC macro facility, as extended by Version 2.0 of Softool's Change and Configuration Control Environment, offers many new and powerful features. Among these are a vastly extended suite of commands, error trapping, and structured constructs. In concert with previously existing Version 1.x features (notably the very powerful symbol substitution and parameter passage facilities), these features combine to transform the macro facility from a simple command language into an extremely flexible programming language which is suitable for developing very large and complex applications. This paper presents the results of a performance analysis of the CCC macro facility conducted at the Los Alamos National Laboratory Weapons Neutron Research Facility. The goal of this work was to identify and evaluate major factors that can contribute to the degradation of performance of the CCC macro facility, and to develop strategies for countering their effects. In particular, we report on the Los Alamos Macro Accelerator, which can produce dramatic increases in execution speed for many applications.

1937 (USGS-OFR—85-233) POLYGON: an interactive program for constructing and editing the geometries of polygons using a color graphics terminal. Chuchel, B.A. (Geological Survey, Menlo Park, CA (USA)). 1985. Contract AI08-78ET44802. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86001419.

This report is a user manual for the FORTRAN program POLYGON. POLYGON is designed to facilitate the construction and editing of the geometries of polygonal shapes using an Envision color-graphics terminal. The Open-File Report number 85-233-B [Chuchel, 1985] contains a listing of the FORTRAN source code for the POLYGON program. POLYGON features color-graphics, an interactive user dialogue, brief help messages, and "zooming" to selected portions of the terminal screen in order to edit and manipulate polygons using a graphics cursor or the Envision mouse. A quadruply linked tree is used within POLYGON to represent and store the information about the geometries of the polygons. These polygonal shapes may subsequently be used by independent modeling programs to represent three-dimensional shapes of gravitational or magnetic sources; for example, output from POLYGON is directly compatible with programs MAGPOLY or GRAVPOLY and PFGRAV3D or PFMAG3D. POLYGON is written in DEC (Digital Equipment Corporation) extended FORTRAN 77 and is presently operational on the USGS, Branch of Geophysics, VAX/VMS computer. The program is written to operate on the Envision 200 series of color graphics terminals by Envision Technology Incorporated. Suggestions are provided on converting the program to other types of color terminals.

1938 Quantum chemistry with an attached processor. Bair, R.A.; Dunning, T.H. Jr. (Argonne National Lab., IL). *Journal of Computational Chemistry;* **1**: 44-55(Feb 1984).

The Floating Point Systems Inc. model 164 attached processor (FPS-164) is a high-speed, pipelined, parallel processor designed for large-scale scientific computation. Benchmark studies of operations common in quantum chemistry codes are discussed and the performance of the FPS-64 is compared with other commonly available computers. A complete system of electronic structure codes has been implemented on the FPS-164 using the FORTRAN-77 cross-compiler and calls to optimized vector and matrix routines. The conversion of a generalized valence bond (GVB) code illustrates the strategy adopted to adapt FORTRAN codes to the FPS-164. A typical production example, a large scale gvb and configuration interaction calculation on the vinyl radical, shows a net throughput equivalent to nearly nine VAX 11/780 computers. 13 references.

1939 Application of artificial intelligence to triple quadrupole mass spectrometer (TQMS). Wong, C.M.; Crawford, R.W.; Kunz, J.C.; Kehler, T.P. (Lawrence Livermore National Lab., CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **1**: 804-810(Feb 1984).

From 1983 nuclear science symposium and 1983 symposium on nuclear power systems; San Francisco, CA, USA (19 Oct 1983).

At Lawrence Livermore National Laboratory, a totally computerized triple quadrupole mass spectrometer (TQMS) was designed to be used as a prototype for knowledge-based instrument control, i.e. as an intelligent instrument. In this context, intelligent implies ability to respond to novel situations and new problems, or to apply the experience that has been taught, and to use the power of reasoning and inference effectively to control behavior. With its

computer-based data acquisition and control system, it has the ability to learn or respond quickly. The intelligence is encoded in the system using the representation and rule-based reasoning heuristic techniques of artificial intelligence. In the TQMS, the knowledge base is for the tuning of a TQMS, and the heuristics describe a self-adaptive feedback control process for real-time optimization or tuning throughout the entire data collector process. 11 references.

1940 **Some predictions on the performance of future supercomputers for simulation and control.** Davidson, H.L. (Lawrence Livermore National Lab., CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **1**: 23-26(Feb 1984).

From 1983 nuclear science symposium and 1983 symposium on nuclear power systems; San Francisco, CA, USA (19 Oct 1983).

The author discusses what is meant by the term supercomputers and considers reasons why their performance is not as high as one would like and techniques for improving this performance. Predictions of how fast they will become in near future and some interesting and entertaining applications they might solve are also discussed. 17 references.

1941 **Centralized supercomputer support for magnetic fusion energy research.** Fuss, D.; Tull, C.G. (Lawrence Livermore National Lab., CA). *Proceedings of the IEEE (Institute of Electrical and Electronics Engineers);* **1**: 32-41(Jan 1984).

The authors discuss the National Magnetic Fusion Energy Computer Center (NMFECC), established in 1974 at the Lawrence Livermore National Laboratory. Supercomputers at the central computing facility are linked to smaller computer centers at each of the major fusion laboratories by a satellite communications network. In addition to providing large-scale computing, the NMFECC environment stimulates collaboration and the sharing of a computer codes and data among the many fusion researchers in a cost-effective manner. The need for high-speed computers with large memories is covered. The application of NMFECC to studies in magnetohydrodynamics (MHD), transport, equilibrium, Vlasov, particle, and Fokker-Planck codes that model plasma behaviour is described. 9 references.

1942 **Gaining insight from supercomputing.** Buzbee, B.L. (Los Alamos National Lab., NM). *Proceedings of the IEEE (Institute of Electrical and Electronics Engineers);* **1**: 19-21(Jan 1984).

Supercomputers play important roles in various areas of science, but perhaps their greatest value lies in their ability to help scientists gain insight or understanding. They do this by enabling scientists to treat complexity in modes that are not otherwise tractable, by enabling scientists to study phenomena that are difficult to study experimentally and by helping to test theory. This paper discusses associated examples. 38 references.

1943 **Implementing linear algebra algorithms for dense matrices on a vector pipeline machine.** Dongarra, J.J.; Gustavson, F.G.; Karp, A. (Argonne National Lab., IL). *SIAM (Society for Industrial and Applied Mathematics) Review;* **1**: 91-112(Jan 1984).

The authors examine common implementations of linear algebra algorithms, such as matrix-vector multiplication, matrix-matrix multiplication and the solution of linear equations. The different versions are examined for efficiency on a computer architecture which uses vector processing and has pipelined instruction execution. By using the advanced architectural features of such machines, one can usually achieve maximum performance, and tremendous improvements in terms of execution speed can be seen over conventional computers. 17 references.

9903 Information Handling

REFER ALSO TO CITATION(S) 1629, 1931

1944 **(EUR—9097-EN) Directory of energy data bases.** (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 153p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The report contains an inventory of energy data bases accessible in the 10 community countries. The data bases included in this inventory have the following characteristics in common: they cover solely the fields of energy or contain a significant percentage of information on energy, all the data bases listed are computer-aided and are accessible either on-line or by direct interrogation to the producer. The inventory is completed by an index of producers and host centres.

1945 **(UIUCDCS-R—85-1225) Initial report on Isadore: a reference librarian generator.** Shilling, J. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Sep 1985. Contract AC02-76ER02383. 22p. (UILU-ENG—85-1737; COO—2383-0112). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001404.

An automated reference librarian is a computer program which helps the user locate and use objects from programming libraries. Its function is analogous to the function of a reference librarian in a public or academic library. A reference librarian's job is to be an expert on locating information. A client comes to the librarian with a need for information and the librarian connects the client with the source of the information he needs, perhaps even instructing him on how to use the reference materials. In the same way an automated reference librarian will help the user find programming objects in software libraries. The librarian will help the programmer use the located objects by helping him construct the interface between the object he is creating and the library object that he needs.

1946 **Trends in laboratory information management systems.** Gibbon, G.A. (Pittsburgh Energy Technology Center, PA). *TrAC, Trends in Analytical Chemistry (Personal Edition);* **3**: No. 2, 36-38(1984).

Laboratory Information Management Systems (LIMS) are an outgrowth of laboratory automation, the increasing workload in most laboratories, and the success that Information Management Systems have shown in enhancing productivity in a wide variety of activities. One current need is a model for constructing a local area network for the LIMS.

CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

DOE Energy Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Academia de Ciencias do Estado de Sao Paulo (Brazil)
Proceedings of the 4. Japan-Brazil Symposium on Science and Technology. Vol. 2, 11:1358 (R;BR)

ACEC Research and Management Foundation, Washington, DC (USA)
Industrial energy management: leveraging a national effort for increasing industrial energy management technology. Quarterly status report, July 1, 1985-September 30, 1985, 11:763 (R;US)

Adelphi Univ., Garden City, NY (USA). Center for Energy Studies
Tidal energy project for application in the East River, New York, 11:435 (R;US)

Advanced Battery Group, Lancaster, NY (USA)
Safety characteristics of non-lithium battery systems. Final report for period ending FY84, 11:758 (R;US)

Advanced Technology Associates, Inc., Dublin, CA (USA)
Principles for protecting material accounting systems from data falsification, 11:243 (R;US)

Aerospace Corp., El Segundo, CA (USA)
Trapping of ion conics by downward parallel electric fields. Technical report, 11:1509 (R;US)

AIDCO Maine Corp., Orr's Island (USA)
Conversion of coastal waters into solar ponds. Final report, 11:405 (R;US)

Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)
Computation of angle averaged cross sections in a degenerate Compton scattering medium, 11:1839 (R;US)

Air Force School of Aerospace Medicine, Brooks AFB, TX (USA)
Predictive model of electron-beam-induced flashblindness. Final report, November 1983-October 1984, 11:1407 (R;US)

Air Products and Chemicals, Inc., Allentown, PA (USA)
Pilot plant development of a chemical air separation process. Interim report, October 1, 1982-September 30, 1984, 11:835 (R;US)

Alabama Univ., Huntsville (USA). Dept. of Chemical Engineering
Direct coal liquefaction using iron-titanium hydride as a hydrogen distribution and catalytic material. Yearly report No. 1, September 1, 1984-August 31, 1985, 11:14 (R;US)

Alaska State Dept. of Natural Resources, Anchorage (USA). Div. of Geological and Geophysical Surveys
Map of DGGS publications with author and quadrangle indexes. Information Circular 23, 11:1473 (R;US)

Alaska Univ., Fairbanks (USA). Geophysical Inst.
Geothermal energy resource investigations in the Eastern Copper River Basin, Alaska, 11:420 (R;US)

Alaska Univ., Palmer (USA). Alaska Agricultural and Forestry Experiment Station
Research on revegetation of Alaskan coal mine spoils. Section I - Plant material studies. Section II - Wildlife habitat use studies. Progress report, 1983, 11:55 (R;US)
Revegetation of Alaskan coal mine spoils. Final report, 11:62 (R;US)

Alexander (Richard), Mayville, NY (USA)
IATS final report, 11:808 (R;US)

Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.
IGES translator analysis for Autofact '85, 11:1933 (R;US)
Motion analysis. Final report, 11:1155 (R;US)
Solid modeling and IGES, 11:1932 (R;US)

American Nuclear Society, La Grange Park, IL
Twelfth biennial conference on reactor operating experience maintenance and modifications for availability and efficiency, 11:481 (B;US)

Ames Lab., IA (USA)
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Qualifier
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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC03-84ER53158	**GA Technologies, Inc., San Diego, CA (USA)**	
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	Resource Management Associates, Lafayette, CA (USA)	
	11:1475	RHO-C—20
AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
	11:158	NUREG/CR—4345
	11:184	EGG—2411
	11:290	EGG-EA—6775
	11:505	NUREG/CR—4272
	11:570	NUREG/CR—4141
	11:611	EGG-RST—6956
	Argonne National Lab., Idaho Falls, ID (USA)	
	11:613	EPRI-NP—4113-SR(Jul 1985).
	11:614	EPRI-NP—4113-SR(Jul 1985).
	11:615	EPRI-NP—4113-SR(Jul 1985).
	11:646	EPRI-NP—4113-SR(Jul 1985).
	11:647	EPRI-NP—4113-SR(Jul 1985).
	11:650	EPRI-NP—4113-SR(Jul 1985).
	11:651	EPRI-NP—4113-SR(Jul 1985).

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	11:662	EPRI-NP—4113-SR(Jul 1985).
	11:677	EPRI-NP—4113-SR(Jul 1985).
	EG and G Idaho, Inc., Idaho Falls (USA)	
	11:727	NUREG/CR—3633-Vol.4
	Argonne National Lab., IL (USA)	
	11:1875	CONF-850814—10
AC07-78RA04934	**Franklin Pierce Law Center, Concord, NH (USA). Energy Law Inst.**	
	11:292	DOE/RA/04934—2
AC07-79ID12079		
	Utah Univ. Research Inst., Salt Lake City (USA). Earth Sciences Lab.	
	11:422	DOE/ID/12079—128
AC07-82CE40544	**Air Products and Chemicals, Inc., Allentown, PA (USA)**	
	11:835	DOE/CE/40544—T1
AC07-84ID12537	**United Technologies Research Center, East Hartford, CT (USA)**	
	11:972	DOE/ID/12537—1
AC08-80DP40124	**Rochester Univ., NY (USA). Lab. for Laser Energetics**	
	11:1878	DOE/DP/40124—35
AC08-81NV10162	**Nevada Univ., Las Vegas (USA). Water Resources Center**	
	11:1322	DOE/NV/10162—20
AC08-83NV10282	**EG and G, Inc., Goleta, CA (USA). Santa Barbara Operations**	
	11:110	EGG—10282-2080
	EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations	
	11:1251	EGG—10282-2068
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	11:182	DP-MS—85-58
	11:183	DPST—80-262
	11:1308	DPST—85-552
	11:1323	DP-MS—85-91
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
	11:1344	DPSPU—84-11-11
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	11:1445	DPST—84-742
AC11-76PN00014	**Bettis Atomic Power Lab., West Mifflin, PA (USA)**	
	11:748	WAPD-T—2834
AC21-81MC16518	**Brigham Young Univ., Provo, UT (USA). Combustion Lab.**	
	11:6	DOE/MC/16518—T1-Vol.1
	11:7	DOE/MC/16518—T1-Vol.2
	11:78	DOE/MC/16518—T1-Vol.3
AC21-84MC21108	**UCC Research Corp., Bristol, VA (USA)**	
	11:8	DOE/MC/21108—3
	11:46	DOE/MC/21108—T1
AC22-80ET15602	**FluiDyne Engineering Corp., Minneapolis, MN (USA)**	
	11:791	DOE/ET/15602—T16
AC22-83PC60015	**Wyoming Univ., Laramie (USA). Office of Univ. Research**	
	11:36	DOE/PC/60015—30
AC22-83PC60045	**Battelle Columbus Labs., OH (USA)**	
	11:70	DOE/PC/60045—T7
AC22-83PC60264	**Battelle Columbus Labs., OH (USA)**	
	11:462	DOE/PC/60264—T2
AC22-85PC81510	**Management and Technical Services Co., Philadelphia, PA (USA)**	
	11:79	DOE/PC/81510—T2
AC79-81BP29182	**Oregon State Univ., Corvallis (USA). Wind Resources Assessment Lab.**	
	11:440	DOE/BP/29182—15
	11:441	DOE/BP/29182—16
AC79-83BP11286	**Brown (Larry) and Associates, Grants Pass, OR (USA)**	
	11:301	DOE/BP/11286—1
AC79-83BP11902	**IEC Beak Consultants Ltd., Richmond, British Columbia (Canada)**	
	11:1353	DOE/BP/11902—2
AI01-76ET10393	**NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)**	
	11:75	DOE/ET/10393—1904-Vol.2
	11:76	DOE/ET/10393—1905-Vol.2
AI01-76ET20320	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	11:442	DOE/NASA/20320—66
AI01-76ET20356	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	11:306	ERDA/JPL/1012—76/1
	11:307	ERDA/JPL/1012—76/4
	11:309	JPL—5101-18
	11:310	JPL—5101-29
	11:311	JPL—5101-37
	11:312	JPL—5101-52
AI01-77CS51040	**Garrett Turbine Engine Co., Phoenix, AZ (USA)**	
	11:855	DOE/NASA/0167—9
AI01-78CS54209	**Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Electromagnetic and Electronic Systems**	
	11:858	DOE/CS/54209—26
	Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Electrical Engineering	
	11:859	DOE/CS/54209—27-Vol.2
	Missouri Univ., Columbia (USA). Dept. of Electrical and Computer Engineering	
	11:860	DOE/CS/54209—28
AI01-80CS40381	**Department of Agriculture, Beltsville, MD (USA)**	
	11:786	DOE/CS/40381—T1
AI01-80CS50194	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	11:856	DOE/NASA/50194—43
AI01-81CS50006	**Wisconsin Univ., Madison (USA)**	
	11:854	DOE/CS/50006—2
AI07-81ID12307	**Southern Methodist Univ., Dallas, TX (USA). Dept. of Geological Sciences**	
	11:423	DOE/ID/12307—1
AI08-78ET44802	**Geological Survey, Denver, CO (USA)**	
	11:203	USGS-OFR—85-459
	Geological Survey, Menlo Park, CA (USA)	
	11:1491	USGS-OFR—85-377
	11:1937	USGS-OFR—85-233
AI79-84BP12737	**Oregon Dept. of Fish and Wildlife, Corvallis (USA)**	
	11:1354	DOE/BP/12737—1
	11:1355	DOE/BP/12737—2
AM03-76SF00113	**Univ. of Southern California, Marina del Rey**	
	11:1260	Scanning Electron Microscopy 9-14 (1984).
AP07-79ID00019	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	11:1899	PFC/RR—85-6
AS03-84ER13164	**California Univ., Santa Barbara (USA). Dept. of Mechanical and Environmental Engineering**	
	11:1177	DOE/ER/13164—T3
AS05-76ER03956	**Universite de l'Etat Faculte des Sciences, Mons, Belgium**	
	11:1581	Zeitschrift fuer Physik [Sektion] C: Particles and Fields 22 119-124 (1984).
AS05-76ER04310	**Smithsonian Institution, Rockville, MD (USA). Smithsonian Environmental Research Center**	
	11:302	DOE/ER/04310—T4
AS05-76EV03861	**Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy**	
	11:996	DOE/EV/03861—50
AS05-77ER05490	**Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy**	
	11:1601	DOE/ER/05490—69

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AS05-78ER06034	**Univ. of North Carolina, Chapel Hill**	
	11:1069	Inorganic Chemistry 24 NO. 18. 2755-2763 (28 Aug 1985).
AS05-79ER10332	**George Washington Univ., Washington, DC (USA). Office of Sponsored Research**	
	11:1638	DOE/ER/10332—15
AS05-79ER10419	**Florida State Univ., Tallahassee (USA). Dept. of Physics**	
	11:1734	DOE/ER/10419—4
AS05-79ER10505	**Univ. of New Orleans, LA**	
	11:1150	Combustion and Flame 54 49-59 (1983).
AS05-80ER10578	**Texas A and M Univ., College Station (USA). Dept. of Physics**	
	11:1544	DOE/ER/10578—3
	11:1545	DOE/ER/10578—5
AS05-80ER10702	**Rutgers Univ., New Brunswick, NJ**	
	11:1047	Analytical Biochemistry 140 1-5 (1984).
AS05-80ER10713	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
	11:1574	DOE/ER/10713—4B
AS05-80ER10742	**North Carolina State Univ., Raleigh (USA). Dept. of Physics**	
	11:1229	DOE/ER/10742—4
AS05-80ER10745	**Univ. of Houston, TX**	
	11:1103	Journal of Physical Chemistry 89 NO. 10. 2087-2089 (9 May 1985).
	11:1128	Journal of Physical Chemistry 89 NO. 11. 2415-2419 (23 May 1985).
AS05-80EV10363	**Univ. of Tennessee, Knoxville**	
	11:1113	Synthetic Communications 14 NO. 8. 755-760 (1984).
	Tennessee Univ., Knoxville (USA). Dept. of Chemistry	
	11:1138	DOE/EV/10363—7
	11:1139	DOE/EV/10363—8
AS05-81EV10726	**Texas A and M Univ., College Station (USA). Air Quality Lab.**	
	11:82	DOE/EV/10726—T1
AS05-82ER12088	**Imperial College, London, England**	
	11:1104	Journal of Organic Chemistry 50 NO. 5. 596-603 (8 Mar 1985).
AS05-82ER13023	**Texas A & M Univ., College Station**	
	11:1039	Analytical Chemistry 57 NO. 7. 1211-1216 (Jun 1985).
AS05-84ER13147	**Texas Univ., Austin (USA). Dept. of Physics**	
	11:1934	DOE/ER/13147—2
AS05-85ER53193	**Texas Univ., Austin (USA). Fusion Research Center**	
	11:1823	DOE/ET/53193—2-276
AS09-80EV10331	**Skidaway Institute of Oceanography, Savannah, GA**	
	11:1503	44-50 (1983).
AS09-83ER13107	**Georgia Univ., Athens (USA)**	
	11:1367	DOE/ER/13107—3
AS19-83BC10811	**Oklahoma State Univ., Stillwater (USA). Dept. of Botany and Microbiology**	
	11:90	DOE/BC/10811—1
AT03-76ER70068	**Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.**	
	11:1060	DOE/ER/70068—T3
AT03-78ER70277	**California Univ., Santa Barbara (USA). Dept. of Chemistry**	
	11:1125	DOE/ER/70277—T2
AT06-71EV70024	**Washington Univ., Seattle (USA). School of Oceanography**	
	11:1334	DOE/EV/70024—T1
AT06-79EV10256	**Alaska Univ., Palmer (USA). Alaska Agricultural and Forestry Experiment Station**	
	11:55	DOE/EV/10256—T5
	11:62	DOE/EV/10256—T4
AT06-83ER45038	**Washington Univ., Seattle (USA). Dept. of Physics**	
	11:994	CONF-840764—8
FC02-80CS30529	**Solar Concepts Development, Inc., Davis, CA (USA)**	
	11:376	DOE/CS/30529—1
FC02-80ET20643	**Midwest Research Inst., Kansas City, MO (USA)**	
	11:392	MRI/SOL—0201
FC05-77ET10069	**Exxon Research and Engineering Co., Annandale, NJ (USA)**	
	11:5	DOE/ET/10069—T117
FC07-82CS40419	**Construction Technology Labs., Skokie, IL (USA)**	
	11:836	DOE/CS/40419—8
	11:837	OE/CS/40419—10
FC19-83FE60149	**National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)**	
	11:91	NIPER—85
FC21-83FE60181	**North Dakota Univ., Grand Forks (USA). Energy Research Center**	
	11:1	DOE/FE/60181—1845
	11:77	DOE/FE/60181—140
FG01-80CS15006	**Underground Systems, Arcadia, CA (USA)**	
	11:137	CAPE—2962([1982]).
FG01-80CS83003	**High Plains Energy Forum, Dodge City, KS (USA)**	
	11:283	CONF-7910328—Pt.2
FG01-80MI01010	**Atlanta Univ., GA (USA). Dept. of Political Science**	
	11:832	DOE/MI/01010—T1
FG01-80RA50013	**Michigan Energy and Resource Research Association, Detroit (USA)**	
	11:81	DOE/RA/50013—T1
FG01-85CE40732	**ACEC Research and Management Foundation, Washington, DC (USA)**	
	11:763	DOE/CE/40732—T1
FG01-85PE77015	**Keystone Center, CO (USA)**	
	11:779	DOE/PE/77015—T1
FG02-80ER10725	**Missouri Univ., Columbia (USA). Research Reactor Facility**	
	11:584	DOE/ER/10725—2
FG02-84ER13187	**Battelle-Charles F. Kettering Research Lab., Yellow Springs, OH (USA)**	
	11:303	DOE/ER/13187—2
FG02-84ER13231	**V.A. Medical Center, Omaha, NE**	
	11:1034	Analytical Chemistry 57 NO. 9. 1937-1941 (Aug 1985).
FG02-84ER60242	**Colorado Univ., Boulder (USA). Inst. of Arctic and Alpine Research**	
	11:1319	DOE/ER/60242—2
FG02-84ER60243	**Illinois Univ., Urbana (USA). Dept. of Ecology, Ethology and Evolution**	
	11:1326	DOE/ER/60243—T1
FG02-85ER13340	**Colorado State Univ., Fort Collins (USA)**	
	11:1059	DOE/ER/13340—1
FG02-85ER60292	**New York Botanical Garden, NY (USA). Inst. of Ecosystem Studies**	
	11:1289	DOE/ER/60292—1
FG03-78SF01949	**Solar AquaSystems, Inc., Encinitas, CA (USA)**	
	11:262	DOE/SF/01949—T1
FG03-79SF10570	**La Malo'o Dried Fruit, Pahoa, HI (USA)**	
	11:286	DOE/SF/10570—T1
FG03-80R950012	**Huffman (Donald R.), Tucson, AZ (USA)**	
	11:388	DOE/R9/50012—T1
FG03-80R950040	**Hanson (Thomas F.), Newhall, CA (USA)**	
	11:447	DOE/R9/50040—T1
FG03-81SF11603	**Sussman (Arthur J.), Point Arena, CA (USA)**	
	11:765	DOE/SF/11603—T1
FG03-81SF11607	**Datatrace, Inc., Los Angeles, CA (USA). Stirling Experimental Div.**	
	11:857	DOE/SF/11607—T1
FG03-81SF11608	**College of the Siskiyous, Weed, CA (USA)**	
	11:842	DOE/SF/11608—T1

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FG03-81SF11613	EnBio, Inc., Fairfield, CA (USA)	
	11:263	DOE/SF/11613—T1
FG03-81SF11614	Schlussler (Larry), Arcata, CA (USA)	
	11:389	DOE/SF/11614—T1
FG03-81SF11618	Scientific Associates, Inc., Santa Monica, CA (USA)	
	11:448	DOE/SF/11618—T1
FG03-81SF11620	Hoopa Valley Business Council, Hoopa, CA (USA). Planning Dept.	
	11:437	DOE/SF/11620—T1
FG03-81SF11624	Caliente, City of, NV (USA)	
	11:433	DOE/SF/11624—T1
FG03-81SF11627	SUNN, Inc., Window Rock, AZ (USA)	
	11:390	DOE/SF/11627—T1
FG05-80ET53088	Texas Univ., Austin (USA). Inst. for Fusion Studies	
	11:1819	DOE/ET/53088—184
	11:1820	DOE/ET/53088—201
	11:1821	DOE/ET/53088—205
	11:1822	DOE/ET/53088—208
FG05-83OR21389	CONEG Policy Research Center, Inc., Washington, DC (USA)	
	11:287	DOE/OR/21389—7
FG05-83OR21390	Council of Great Lakes Governors, Inc., Madison, WI (USA)	
	11:787	DOE/OR/21390—7
	11:788	DOE/OR/21390—8
FG05-84ER40152	Vanderbilt Univ., Nashville, TN (USA)	
	11:1575	DOE/ER/40152—1
FG06-79R000036	Hart (Elizabeth A.), Fairbanks, AK (USA)	
	11:377	DOE/R0/00036—T1
FG06-79R000070	White Mountain Cooperative Community, Wauconda, WA (USA)	
	11:443	DOE/R0/00070—T1
FG06-80ET34032	Studsvik Energiteknik AB, Nykoeping (Sweden)	
	11:610	DOE/ET/34032—1
FG06-80R000454	Christofferson (John E.), Idaho Falls, ID (USA)	
	11:863	DOE/R0/00454—T1
FG06-81R001238	Tilth Association, Seattle, WA (USA)	
	11:838	DOE/R0/01238—T1
FG06-81R001318	Bohemia Solar and Scientific, Inc., Eugene, OR (USA)	
	11:404	DOE/R0/01318—T1
FG06-84ER45163	Washington Univ., Seattle (USA). Dept. of Physics	
	11:879	DOE/ER/45163—2
FG07-84ID12471	Alaska Univ., Fairbanks (USA). Geophysical Inst.	
	11:420	DOE/ID/12471—T1
FG09-84ER13248	Georgia Univ., Athens (USA)	
	11:1398	DOE/ER/13248—2
FG22-82PC50797	California Univ., Riverside (USA). Dept. of Chemistry	
	11:1062	DOE/PC/50797—T11
FG22-82PC50810	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
	11:260	DOE/PC/50810—T11
FG22-83PC60787	Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering	
	11:11	DOE/PC/60787—8
FG22-83PC60804	Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science	
	11:1094	DOE/PC/60804—T8
FG22-84PC70006	Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining	
	11:38	DOE/PC/70006—T4
FG22-84PC70796	Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering	
	11:71	DOE/PC/70796—5
FG22-84PC70799	Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)	
	11:39	DOE/PC/70799—T3
FG22-84PC70801	Illinois Univ., Urbana (USA). Dept. of Chemical Engineering	
	11:12	DOE/PC/70801—2
FG22-84PC70809	University of Southern California, Los Angeles (USA)	
	11:40	DOE/PC/70809—T3
FG22-84PC70812	Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering	
	11:13	DOE/PC/70812—4
FG22-84PC70814	Alabama Univ., Huntsville (USA). Dept. of Chemical Engineering	
	11:14	DOE/PC/70814—1
FG22-85PC81504	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
	11:72	DOE/PC/81504—T1
FG41-79R110007	High Meadows Farm, Westminster West, VT (USA)	
	11:839	DOE/R1/10007—T1
FG41-79R110039	New Horizons for New Hampshire, Inc., Manchester (USA)	
	11:378	DOE/R1/10039—T1
FG41-79R110046	Community School at Packard Manse, Stoughton, MA (USA)	
	11:1209	DOE/R1/10046—T1
FG41-79R110059	McClintock (Michael), Boston, MA (USA)	
	11:305	DOE/R1/10059—T1
FG41-79R110060	Community Renewal Team of Greater Hartford, Inc., CT (USA)	
	11:379	DOE/R1/10060—T1
FG41-79R110065	Sunsearch, Inc., Guilford, CT (USA)	
	11:419	DOE/R1/10065—T1
FG41-80R110342	Parsons (Daniel), Richford, VT (USA)	
	11:840	DOE/R1/10342—T1
FG41-80R110345	Gardy (Victor R.), Shelburne, VT (USA)	
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FG41-80R110385	Rural Education Center, Inc., Wilton, NH (USA)	
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FG41-80R110402	Fort Pelham Wood Products, Rowe, MA (USA)	
	11:841	DOE/R1/10402—T1
FG41-80R110403	Housing Now, Inc., North Adams, MA (USA)	
	11:381	DOE/R1/10403—T1
FG41-80R110425	Brattleboro Design Group, VT (USA)	
	11:382	DOE/R1/10425—T1
FG41-81R121263	BRR Corp., New London, CT (USA)	
	11:1208	DOE/R1/21263—T1
FG41-81R122238	Kleinschmidt and Dutting, Pittsfield, ME (USA)	
	11:434	DOE/R1/22238—T1
FG41-81R122239	AIDCO Maine Corp., Orr's Island (USA)	
	11:405	DOE/R1/22239—T1
FG41-81R123271	Guernsey (David W.), Concord, MA (USA)	
	11:288	DOE/R1/23271—T1
FG41-81R123279	TDEnergy, Inc., Boston, MA (USA)	
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FG41-81R123281	Taylor (Robert M.), Boston, MA (USA)	
	11:789	DOE/R1/23281—T1
FG41-81R125251	Applied Science Associates, Inc., Wakefield, RI (USA)	
	11:436	DOE/R1/25251—T1
FG41-81R126232	Wever, Inc., South Burlington, VT (USA)	
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FG41-81R126235	Vermont Iron Stove Works, Inc., Waterbury (USA)	
	11:807	DOE/R1/26235—T1
FG42-79R205015	Petzenbaum (Hannah), Flushing, NY (USA)	
	11:383	DOE/R2/05015—T1
FG42-79R205016	Sol Control Co., Inc., Troy, NY (USA)	
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FG42-79R205033	**Cumberland County Coll., Vineland, NJ (USA)**	
	11:386	DOE/R2/05033—T1
FG42-79R205040	**Alexander (Richard), Mayville, NY (USA)**	
	11:808	DOE/R2/05040—T1
FG42-79R205041	**Rhoads (Willard L.), Rochester, NY (USA)**	
	11:445	DOE/R2/05041—T1
FG42-79R205063	**Montclair Dept. of Public Works, NJ (USA)**	
	11:851	DOE/R2/05063—T1
FG42-80R205146	**Raymond (Frank E.), Grafton, NY (USA)**	
	11:446	DOE/R2/05146—T1
FG42-80R205152	**State Univ. of New York, Fredonia (USA). Dept. of Biology**	
	11:261	DOE/R2/05152—T1
FG42-80R205164	**Hayford (William H.), Hewitt, NJ (USA)**	
	11:407	DOE/R2/05164—T1
FG42-80R205166	**Adelphi Univ., Garden City, NY (USA). Center for Energy Studies**	
	11:435	DOE/R2/05166—T1
FG42-80R205173	**Pace Univ., Pleasantville, NY (USA)**	
	11:284	DOE/R2/05173—T1
FG42-80R205182	**Ross (William), Brooklyn, NY (USA)**	
	11:387	DOE/R2/05182—T1
FG42-81R205280	**Mount Olive, Township of, NJ (USA)**	
	11:864	DOE/R2/05280—T1
FG44-80R410353	**Floyd (James E.), Cullman, AL (USA)**	
	11:285	DOE/R4/10353—T1
FG48-80CS69129	**Utah Energy Office, Salt Lake City (USA)**	
	11:806	DOE/CS/69129—T1
NAS-7-100-954527	**Springborn Labs., Inc., Enfield, CT (USA)**	
	11:304	DOE/JPL—954527-27/85
W-31-109-ENG-38	**Argonne National Lab., IL (USA)**	
	11:172	ANL/EES-TM—290
	11:179	DOE/NBM—6001405
	11:212	NUREG/CR—2286
	11:219	ANL-OHS/HP—85-102
	11:375	ANL/OTEC-TM—5
	11:477	CONF-8510159—1
	11:506	ANL—85-28
	11:507	ANL—85-56
	United Engineers and Constructors, Philadelphia, PA (USA). Advanced Engineering Dept.	
	11:531	DOE/NBM—5018246
	Argonne National Lab., IL (USA)	
	11:546	NUREG/CR—1969
	11:575	CONF-8510161—1
	11:583	CONF-8410173—13
	11:708	NUREG/CR—1937
	11:720	NUREG/CR—2181-Vol.1
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CONF-760179-	(1. Low-cost Silicon Solar Array (LSSA) task integration meeting, Pasadena, CA, USA, 13-15 Jan 1976)			
Summ.	*See* ERDA/JPL/1012-76/1	E 1.99: DE85015765	MN -63b	11:306
CONF-7604175-	(2. Low-cost Silicon Solar Array (LSSA) project integration meeting, Pasadena, CA, USA, 27-28 Apr 1976)			
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CONF-770168-	(5. Low-cost Silicon Solar Array (LSSA) project integration meeting, San Diego, CA, USA, 17-18 Jan 1977)			
Summ.	*See* JPL-5101-18	E 1.99: DE85015770	MN -63b	11:309
CONF-7705203-	(6. Low-cost Silicon Solar Array (LSSA) project integration meeting, Pasadena, CA, USA, 4-5 May 1977)			
Summ.	*See* JPL-5101-29	E 1.99: DE85015769	MN -63b	11:310
CONF-7708131-	(7. Low-Cost Silicon Solar Array (LSSA) project integration meeting, Pasadena, CA, USA, 10-11 Aug 1977)			
Summ.	*See* JPL-5101-37	E 1.99: DE85015768	MN -63b	11:311
CONF-771299-	(8. Low-Cost Solar Array (LSA) project integration meeting, Pasadena, CA, USA, 7-8 Dec 1977)			
Summ.	*See* JPL-5101-52	E 1.99: DE85015767	MN -63b	11:312
CONF-780436-	(Lecture meeting and exhibition on non-destructive materials testing, Mainz, F.R. Germany, 24-26 Apr 1978)			
2	*See* CE-Trans-7585	DE86900135	MN -25	11:1196
3	*See* CE-Trans-7584	DE86900139	MN -25	11:1197
CONF-7910328-	(High plains energy forum: fuels, alcohol, and methane, Dodge City, KS, USA, 19-21 Oct 1979)			
Pt.2	High Plains Publishers, Inc., Dodge City, KS	TI85010317	ND -61	11:283
CONF-800655-	(21. annual meeting of the Institute of Nuclear Materials Management, Palm Beach, FL, USA, 30 Jun-2 Jul 1980)			
39	*See* BNL-NUREG-27953	TI86000176	MN -15	11:227
40	*See* BNL-NUREG-28003	TI86000126	MN -15	11:228
CONF-810499-	(National Bureau of Standards workshop of R and D needs in backfill for nuclear waste repositories, Gaithersburg, MD, USA, 13-14 Apr 1981)			
2	*See* BNL-NUREG-30107	TI86000935	MN -70	11:173
CONF-810625-	(ASME PVP conference, Denver, CO, USA, 21-26 Jun 1981)			
2	*See* BNL-NUREG-29268	TI86000116	MN -80	11:550
CONF-810768-	(NRC program review meeting, Frankfurt, KY, USA, Jul 1981)			
1	*See* BNL-NUREG-30099	TI86000922	MN -70	11:207
CONF-811103-	(ANS winter meeting, San Francisco, CA, USA, 29 Nov-4 Dec 1981)			
26	*See* BNL-NUREG-29831	TI86000959	MN -80	11:594
CONF-8207119-	(Ground water 82, Johannesburgh, South Africa, 5-7 Jul 1982)			
Absts.	*See* INIS-mf-9767	DE86780025	MN -11	11:1327
CONF-8210147-	(3. symposium on reliability and maintenance, Toulouse, France, 18-22 Oct 1982)			
2	*See* CEA-CONF-7790	DE85752897	MN -80	11:604

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27	*See* GEPP-OP-674	E 1.99:	DE86001646	MN -38	11:1198
CONF-8211212-	(Fall meeting of the Austrian Study Group for Radioactivity Measurements in the Danube Region, Vienna, Austria, 1 Nov 1982)				
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1	*See* CEA-CONF-7773		DE85752814	MN -41	11:1246
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CONF-830330-	(IAEA conference on reliability, Stuttgart, F.R. Germany, 21-25 Mar 1983)				
3	*See* FRA-142-2		DE85752863	MN -78	11:489
CONF-8303148-	(Meeting on standardization of nuclear power plant design and construction, Paris, France, 23 Mar 1983)				
2	*See* FRA-147-3		DE85752864	MN -80	11:562
3	*See* FRA-147-2		DE85752865	MN -80	11:561
4	*See* FRA-147-1		DE85752866	MN -78	11:492
5	*See* FRA-147-4		DE85752867	MN -80	11:563
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1	*See* FRA-142-1		DE85752870	MN -80	11:558
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CONF-8305284-	(Pipeline discharges of effluents to sea, Hermanus, South Africa, 24-26 May 1983)				
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12	*See* CERN-EP-83-150		DE86900002	MN -34D	11:1567
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99	*See* FRA-143-2		DE85752848	MN -78	11:491
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CONF-8404163-	(6. international conference on high energy physics, Nashville, TN, USA, 6-8 Apr 1984)			
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CONF-8404274-	(Workshop on fluid dynamical approaches to many-body problems: fundamental and mathematical aspects, Cantania, Italy, 9-11 Apr 1984)			
1	*See* ISN-84-40	DE85752918	MN -34C	11:1760
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11	*See* DOE/DP/40124-35	E 1.99: DE86001306	MN -21	11:1878
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1	*See* CEA-CONF-7634	DE85752901	MN -79	11:511
CONF-8405357-	(87. annual meeting of the American Ceramic Society, Cincinnati, OH, USA, 8 May 1984)			
1	*See* LBL-19788	E 1.99: DE85015132	MN -25	11:1792
CONF-840611-	(International gas turbine conference and exhibit, Amsterdam, Netherlands, 4-7 Jun 1984)			
	Am. Soc. Mech. Eng., [Pap.], 84-GT-121: 7(Jun 1984)			11:458
CONF-840668-	(7. conference on atmospheric electricity, Albany, NY, USA, 4-8 Jun 1984)			
	54-56(1984)			11:1305
CONF-8406285-	(BMFT-CEA-Department of Energy meeting, Argonne, IL, USA, 25-29 Jun 1984)			
1	*See* CEA-CONF-7652	DE85752830	MN -79	11:596
CONF-8406286-	(HPLC meeting, Fontenay-aux-roses, France, 14-15 Jun 1984)			
1	*See* CEA-CONF-7829	DE86780108	MN -4	11:1132
CONF-8406287-	(Meeting of the CEE working group on hot laboratories and remote handling, Harwell, UK, 13-15 Jun 1984)			
1	*See* CEA-CONF-7844	DE85752887	MN -80	11:530

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CONF-840701-	(Topical meeting on fission product behavior and source term research, Snowbird, UT, USA, 15-19 Jul 1984)				
29	*See* CEA-CONF-7843		DE85752889	MN -78	11:606
CONF-840764-	(3. international EXAFS conference, Stanford, CA, USA, 16-20 Jul 1984)				
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000548	MN -25	11:994
CONF-840805-	(188. meeting of the American Chemical Society, Philadelphia, PA, USA, 26-31 Aug 1984)				
32	*See* BNL-37048	E 1.99:	DE86001735	MN -90b	11:68
CONF-840816-	(22. national heat transfer conference, Niagara Falls, NY, USA, 5-8 Aug 1984)				
25	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018192	MN -95d	11:803
CONF-840887-	(16. international congress on high speed photography and photonics, Strasbourg, France, 27-31 Aug 1984)				
20	*See* CEA-CONF-7496		DE85752837	MN -20f	11:1813
CONF-8408148-	(International school of atomic and nuclear heavy ion interactions, Poiana Brasov, Romania, 28 Aug-8 Sep 1984)				
3	*See* INIS-mf-9901		DE86780042	MN -28	11:1632
4	*See* ZfK-537		DE85702775	MN -34C	11:1772
CONF-8408159-	(4. Japan-Brazil symposium on science and technology, Rio de Janeiro;Sao Paulo, Brazil, 6-9 Aug 1984)				
Vol.2	*See* INIS-BR-294		DE86780033	MN -23	11:1358
CONF-840901-	(ANS topical meeting on reactor physics and shielding, Chicago, IL, USA, 17-19 Sep 1984)				
26	*See* CEA-CONF-7466		DE85752827	MN -78	11:482
CONF-840914-	(International meeting on thermal nuclear reactor safety, Karlsruhe, F.R. Germany, 10-14 Sep 1984)				
29	*See* CEA-CONF-7658		DE85752817	MN -78	11:600
30	*See* CEA-CONF-7659		DE85752818	MN -78	11:601
31	*See* CEA-CONF-7653		DE85752833	MN -78	11:597
32	*See* CEA-CONF-7654		DE85752834	MN -78	11:598
33	*See* CEA-CONF-7655		DE85752835	MN -78	11:599
CONF-8409117-	(2. international conference on the science of hard materials, Rhodes, Greece, 23-28 Sep 1984)				
6	*See* UCRL-90188	E 1.99:	DE86001577	MN -25	11:959
CONF-8409162-	(6. international symposium on high energy spin physics, Marseille, France, 12-19 Sep 1984)				
16	*See* ISN-84-42		DE85752921	MN -34C	11:1640
CONF-8409255-	(Residential conference on reliability aspects: from devices to systems, Egham, UK, 11-12 Sep 1984)				
1	*See* KFK-3824		DE85752209	MN -32	11:1935
CONF-841017-	(Specialists' meeting on reactor noise - SMORN IV, Dijon, France, 15-19 Oct 1984)				
11	*See* CEA-CONF-7532		DE85752819	MN -80	11:574
12	*See* CEA-CONF-7530		DE85752828	MN -78	11:486
13	*See* CEA-CONF-7531		DE85752829	MN -78	11:573
CONF-8410136-	(7. ORNL life sciences symposium on indoor-air and human health: major indoor air pollutant and their health implications, Knoxville, TN, USA, 29-31 Oct 1984)				
1	*See* LBL-19346	E 1.99:	DE86000615	MN -41	11:1310
CONF-8410173-	(International meeting on reduced enrichment for research and test reactors, Argonne, IL, USA, 14-18 Oct 1984)				
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001798	MN -80	11:583
CONF-8410204-	(3. European conference on nondestructive testing, Florence, Italy, 15-18 Oct 1984)				
4	*See* CEA-CONF-7672		DE85752883	MN -38	11:1183
5	*See* CEA-CONF-7675		DE85752891	MN -38	11:1184
CONF-8410210-	(7. high energy heavy ion study conference, Darmstadt, F.R. Germany, 8-13 Oct 1984)				
13	*See* IPNO-TH-85-05		DE85752928	MN -34C	11:1759
CONF-8410216-	(Eastern regional meeting of the Society of Petroleum Engineers, Charleston, WV, USA, 31 Oct-2 Nov 1984)				
	Soc. Pet. Eng. AIME, Pap., SPE/DOE/GRI 12836: 21-30(Oct 1984)				11:121
CONF-8410275-	(3. Brazilian congress of energy, Rio de Janeiro, Brazil, 8-11 Oct 1984)				
Vol.2	Centro de Informacoes Nucleares, Rio de Janeiro, Brazil			ND -80	11:553
CONF-8410305-	(3. international seminar on quantum gravitational theory, Moscow, USSR, 23-25 Oct 1984)				
1	*See* JINR-R-2-84-753		DE85702714	MN -34D	11:1623
CONF-8410331-	(Seminar on the results of the indirect action research program: safety of thermal water reactor, Brussels, Belgium, 1-3 Oct 1984)				
1	*See* CEA-CONF-7660		DE85752831	MN -80	11:602
2	*See* CEA-CONF-7661		DE85752832	MN -80	11:1307

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CONF-8410332-	(Meeting on Parkinsons disease, Bari, Italy, 28 Oct 1984)			
1	*See* CEA-CONF-7828	DE85752880	MN -48	11:1369
CONF-8410333-	(International symposium on safety codes and guides in the light of current safety issues, Vienna, Austria, 29 Oct-2 Nov 1984)			
1	*See* CEA-CONF-7841	DE85752888	MN -80	11:605
CONF-841157-	(Materials Research Society annual meeting, Boston, MA, USA, 26-29 Nov 1984)			
91	*See* CEA-CONF-7525	DE85751942	MN -70	11:992
92	*See* CEA-CONF-7526	DE85751943	MN -70	11:993
CONF-841168-	(Specialists' meeting on use of digital computing devices in systems important to safety, Saclay, France, 28-30 Nov 1984)			
1	*See* CEA-CONF-7845	DE85752885	MN -80	11:471
CONF-8411178-	(13. working group meeting on nuclear corrosion, Roma, Italy, 8-9 Nov 1984)			
2	*See* CEA-CONF-7685	DE85752890	MN -78	11:487
CONF-8411200-	(3. international conference of liquid metal engineering and technology in energy production, Geel, Belgium, 12-16 Nov 1984)			
1	*See* CEA-CONF-7784	DE85752917	MN -79	11:527
CONF-841203-	(6. international conference on fracture, New Delhi, India, 4-10 Dec 1984)			
7	*See* CEA-CONF-7697	DE85752892	MN -78	11:873
8	*See* CEA-CONF-7696	DE85752893	MN -25	11:872
CONF-841210-	(International chemical congress of Pacific Basin Society, Honolulu, HI, USA, 16-21 Dec 1984)			
26	*See* CEA-CONF-7501	DE85752896	MN -4	11:1136
CONF-841218-	(31. national vacuum symposium, Reno, NV, USA, 3-7 Dec 1984)			
27	*See* GEPP-OP-836	E 1.99: DE86001647	MN -41	11:1160
CONF-850112-	(7. international conference on nondestructive evaluation in the nuclear industry, Grenoble, France, 29 Jan-1 Feb 1985)			
3	*See* CEA-CONF-7492	DE85752820	MN -78	11:484
4	*See* CEA-CONF-7491	DE85752821	MN -78	11:483
5	*See* CEA-CONF-7494	DE85752822	MN -79	11:509
6	*See* CEA-CONF-7490	DE85752823	MN -80	11:552
7	*See* CEA-CONF-7489	DE85752824	MN -80	11:551
8	*See* CEA-CONF-7487	DE85752825	MN -79	11:508
9	*See* CEA-CONF-7493	DE85752826	MN -78	11:485
CONF-850211-	(114. AIME annual meeting (includes Society of Mining Engineers), New York, NY, USA, 24-28 Feb 1985)			
16	*See* LBL-20044	E 1.99: DE86000625	MN -25	11:892
CONF-850253-	(Peer review meeting on the EPA acid/precipitation and agriculture program, Upton, NY, USA, 4-7 Feb 1985)			
1	*See* BNL-36881	E 1.99: DE86000634	MN -11	11:1443
CONF-8502100-	(15. meeting on actinides, Liege, Belgium, 26-27 Feb 1985)			
1	*See* CEA-CONF-7813	DE85752895	MN -4	11:1137
CONF-8502101-	(8. biennial session on nuclear physics, Aussois, France, 4-8 Feb 1985)			
1	*See* CENBG-8501	DE85752931	MN -34C	11:1648
CONF-850314-	(Waste management '85, Tucson, AZ, USA, 24-28 Mar 1985)			
75	*See* CEA-CONF-7814	DE85752894	MN -70	11:176
CONF-8503101-	(Research and design '85, Los Angeles, CA, USA, 14-18 Mar 1985)			
4	*See* PNL-SA-13040	E 1.99: DE86001645	MN -95d	11:818
CONF-8503184-	(CARTS '85, San Diego, CA, USA, 11-14 Mar 1985)			
1	*See* GEPP-OP-844	E 1.99: DE86001648	MN -38	11:1200
CONF-850402-	(2. international conference on consumer behaviour and energy policy, Paris, France, 10-12 Apr 1985)			
1	*See* LBL-19348	E 1.99: DE86000626	MN -95d	11:811
CONF-850470-	(4. international conference on electrostatic accelerator technology and associated boosters, Buenos Aires, Argentina, 15-19 Apr 1985)			
11	*See* LBL-19171	E 1.99: DE86000602	MN -28	11:1239
CONF-8504180-	(International symposium on propeller and cavitation, Wuxi, Jiangsu, China, 1-5 Apr 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85018447	MN -38	11:1176
CONF-8504183-	(7. General Electric (GE) company-wide materials characterization symposium, Schenectady, NY, USA, 22-24 Apr 1985)			
1	*See* GEPP-OP-896	E 1.99: DE86001663	MN -28	11:1231
2	*See* GEPP-OP-895	E 1.99: DE86001662	MN -25	11:1024
CONF-850504-	(Particle accelerator conference, Vancouver, Canada, 13-16 May 1985)			
287	*See* BNL-36935	E 1.99: DE86001175	MN -28	11:1216
288	*See* UCRL-91940	E 1.99: DE86001578	MN -28	11:1227
290	*See* UCRL-91938	E 1.99: DE86001583	MN -28	11:1226

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291	*See* UCRL-91878	E 1.99: DE86001572	MN -28	11:1240
292	*See* UCRL-91912	E 1.99: DE86001584	MN -34A	11:1241
CONF-850507-	(International conference on nuclear data for basic and applied science, Santa Fe, NM, USA, 13-17 May 1985)			
53	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85018376	MN -20	11:1873
55	*See* UCRL-91947	E 1.99: DE86001559	MN -34C	11:1771
CONF-8505164-	(Workshop on high brightness, high current, high duty factor ion injectors, San Diego, CA, USA, 21-23 May 1985)			
9	*See* LA-UR-85-2942	E 1.99: DE86000790	MN -28	11:1224
CONF-8505193-	(12. annual meeting of the National Organization of Black Chemists and Chemical Engineers, Minneapolis, MN, USA, 22-25 May 1985)			
2	*See* LBL-19331	E 1.99: DE86001480	MN -34A	11:1555
CONF-8505202-	(NASA automation and robotics information exchange workshop, Houston, TX, USA, 13-17 May 1985)			
Vol.1-Exec.Summ.	NTIS, PC A03/MF A01	DE85902195	MN -38	11:1156
Vol.2-Pt.A	NTIS MF A01; 2	DE85902196	MN -38	11:1157
Vol.2-Pt.B	NTIS, PC A17; 3	DE85902197	MN -38	11:1158
CONF-850606-	(American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting, Honolulu, HI, USA, 23-27 Jun 1985)			
16	*See* LBL-19726	E 1.99: DE86000622	MN -41	11:1311
CONF-850610-	(Annual meeting of the American Nuclear Society, Boston, MA, USA, 9-14 Jun 1985)			
34	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85016403	MN -78	11:476
51	NTIS, PC A02/MF A01 - GPO	TI86000085	MN -78	11:608
CONF-850634-	(International school for intermediate energy nuclear physics, Veronna, Italy, 20-30 Jun 1985)			
2	*See* BNL-37038	E 1.99: DE86001193	MN -34C	11:1504
CONF-850660-	(28. conference on Great Lakes research, Milwaukee, WI, USA, 3-5 Jun 1985)			
	Milwaukee, WI; University of Wisconsin (1985).			11:1342
CONF-850672-	(2. international conference on nucleus-nucleus collisions, Visby, Sweden, 10-14 Jun 1985)			
5	*See* LBL-20086	E 1.99: DE86001484	MN -34C	11:1668
6	*See* LBL-20163	E 1.99: DE86001401	MN -34C	11:1635
CONF-8506136-	(Health physics summer school conference, Evanston, IL, USA, 3 Jun 1985)			
3	*See* PNL-SA-13225	E 1.99: DE85017928	MN -41	11:1258
CONF-8506173-	(Workshop on polarized beams at the SSC, Ann Arbor, MI, USA, 10-15 Jun 1985)			
3	*See* BNL-37079	E 1.99: DE86001184	MN -28	11:1222
CONF-8506194-	(International symposium on multiparticle dynamics, Kiryat Anavim, Israel, 1 Jun 1985)			
4	*See* LBL-19992	E 1.99: DE86000616	MN -34D	11:1579
5	*See* BNL-36996	E 1.99: DE86001203	MN -34D	11:1566
7	*See* CERN-EP-85-124	DE86900004	MN -34D	11:1568
CONF-8506196-	(Chapman conference ion acceleration, Wellesley, MA, USA, 3-7 Jun 1985)			
1	*See* LA-UR-85-3232	E 1.99: DE86000772	MN -34B	11:1510
CONF-8506199-	(International astronomical union meeting, Princeton, NJ, USA, 24-28 Jun 1985)			
1	*See* LA-UR-85-3314	E 1.99: DE86000755	MN -34B	11:1506
CONF-8506200-	(10. campus radiation safety officers biennial conference, Ithaca, NY, USA, 25 Jun 1985)			
1	*See* BNL-NUREG-37007	TI86001201	MN -70B	11:229
CONF-850701-	(14. international conference on the physics of electronic and atomic collisions, Palo Alto, CA, USA, 24-30 Jul 1985)			
3	*See* BNL-36976	E 1.99: DE86000030	MN -34A	11:1540
CONF-850702-	(11. Europhysics conference on nuclear physics with electromagnetic probes, Paris, France, 1-6 Jul 1985)			
4	*See* CERN-EP-85-130	DE86900003	MN -34D	11:1569
CONF-850705-	(21. University conference on ceramic science, University Park, PA, USA, 17-19 Jul 1985)			
1	*See* LBL-19160	E 1.99: DE86001483	MN -25	11:1791
CONF-850706-	(8. international symposium on detonation, Albuquerque, NM, USA, 15-19 Jul 1985)			
32	*See* UCRL-93224	E 1.99: DE86000746	MN -45	11:1273
CONF-850708-	(Workshop on tokamak start-up - problems and scenarios related to the transient phases of long-burn operations, Erice, Italy, 14-20 Jul 1985)			
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85018393	MN -20b	11:1874
CONF-850713-	(International conference on nuclear power plant aging, availability factor and reliability analysis, San Diego, CA, USA, 7-12 Jul 1985)			
10	*See* PNL-SA-12855	TI86001641	MN -80	11:746
CONF-850721-	(International Europhysics conference on high energy physics, Bari, Italy, 18-24 Jul 1985)			
5	*See* LA-UR-85-3199	E 1.99: DE86000775	MN -34D	11:1578

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CONF-850734-	(2. international synchrotron radiation instrumentation conference, Stanford, CA, USA, 29 Jul-2 Aug 1985)			
9	*See* LBL-20174	E 1.99: DE86000621	MN -38	11:1165
12	*See* BNL-37050	E 1.99: DE86001205	MN -37	11:1263
13	*See* LA-UR-85-3113	E 1.99: DE86000789	MN -34A	11:1554
CONF-850736-	(American Physical Society topical conference on shock waves in condensed matter, Spokane, WA, USA, 22-26 Jul 1985)			
64	*See* UCRL-93396	E 1.99: DE86001575	MN -34	11:1564
CONF-850759-	(10. high pressure conference on research in high pressure science and technology, Amsterdam, Netherlands, 8-11 Jul 1985)			
15	*See* DOE/ER/45163-2	E 1.99: DE86000545	MN -25	11:879
CONF-850765-	(26. annual meeting of the Institute of Nuclear Materials Management, Albuquerque, NM, USA, 21-24 Jul 1985)			
40	*See* DOE/SR-2001	E 1.99: DE85018512	MN -70	11:181
CONF-850770-	(EXPLOMET '85 - international conference on metallurgical applications of shock wave and high strain-rate phenomena, Portland, OR, USA, 28 Jul-1 Aug 1985)			
12	*See* UCRL-92861	E 1.99: DE86001574	MN -25	11:975
CONF-850784-	(Computer analysis for life science, Okayama, Japan, 9-12 Jul 1985)			
2	*See* LA-UR-85-2985	E 1.99: DE85017542	MN -48	11:1364
CONF-850806-	(Course and workshop on basic physical processes in fusion plasmas, Varenna, Italy, 26 Aug-3 Sep 1985)			
1	*See* GA-A-18113	E 1.99: DE86000311	MN -20	11:1825
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86001348	MN -20a	11:1814
CONF-850809-	(8. international conference on structural mechanics in reactor technology, Brussels, Belgium, 19-23 Aug 1985)			
82	*See* UCRL-91577	E 1.99: DE86000743	MN -20b	11:1904
CONF-850814-	(Cryogenic engineering conference and international cryogenic materials conference, Boston, MA, USA, 12-16 Aug 1985)			
10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85018444	MN -20b	11:1875
14	*See* FNAL-TM-1351	DE86000643	STD -28	11:1230
19	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85016962	MN -20b	11:1876
22	*See* BNL-37019	E 1.99: DE86000032	MN -28	11:1794
23	*See* LA-UR-85-3196	E 1.99: DE86000776	MN -97c	11:754
24	*See* LBL-19246	E 1.99: DE86000619	MN -38	11:1163
25	*See* LBL-19394	E 1.99: DE86000618	MN -28	11:1220
26	*See* LA-UR-85-3195	E 1.99: DE86000777	MN -97c	11:753
27	*See* UCRL-92346	E 1.99: DE86000748	MN -38	11:1169
28	*See* BNL-37044	E 1.99: DE86001195	MN -25	11:871
CONF-850871-	(International conference on neutron scattering, Santa Fe, NM, USA, 19-24 Aug 1985)			
13	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85018407	MN -4	11:1092
17	*See* BNL-36943	E 1.99: DE86000628	MN -25	11:869
18	*See* LA-UR-85-3268	E 1.99: DE86000763	MN -48	11:1365
19	*See* BNL-37043	E 1.99: DE86001196	MN -25	11:1789
CONF-850887-	(SPIE international technical symposium on optical and electro-optical engineers, San Diego, CA, USA, 18-23 Aug 1985)			
38	NTIS, PC A02; 3	DE85018396	MN -25	11:875
39	*See* UCRL-92214	E 1.99: DE86001567	MN -38	11:1268
CONF-850894-	(12. biennial conference on reactor operating experience "maintenance and modifications for availability and efficiency", Williamsburg, VA, USA, 4-7 Aug 1985)			
	La Grange Park, IL; American Nuclear Society Incorporated (1985).			11:481
	Trans. Am. Nucl. Soc., 49 Suppl. 2: 34-35(1985)			11:590
CONF-8508105-	(DOE subcritical reactivity measurements workshop, Albuquerque, NM, USA, 26-29 Aug 1985)			
3	*See* PNL-SA-13357	E 1.99: DE85017930	MN -46	11:1168
5	*See* LA-UR-85-3416	E 1.99: DE86000803	MN -34C	11:545
CONF-8508115-	(American Statistical Association for joint statistical meetings, Las Vegas, NV, USA, 5-8 Aug 1985)			
6	*See* LA-UR-85-3237	E 1.99: DE86000769	MN -32	11:1806
CONF-8508127-	(Nuclear chromodynamics conference, Santa Barbara, CA, USA, 12-13 Aug 1985)			
2	*See* LA-UR-85-3313	E 1.99: DE86000754	MN -34D	11:1600
CONF-8508133-	(NPB program technical interchange meeting, Huntsville, AL, USA, 20-22 Aug 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85018066	MN -28	11:1223
CONF-8508138-	(33. IUPAC general assembly, Lyon, France, 30 Aug-7 Sep 1985)			
1	*See* BNL-NCS-36963	E 1.99: DE86001169	MN -4	11:1015
3	*See* BNL-NCS-36965	E 1.99: DE86001191	MN -34C	11:1653
4	*See* BNL-NCS-36958	E 1.99: DE86001187	MN -4	11:1058
5	*See* BNL-NCS-36952	E 1.99: DE86001177	MN -34A	11:1541

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8	*See* BNL-NCS-36953		DE86001176	MN -34C	11:1686
9	*See* BNL-NCS-36950	E 1.99:	DE86001192	MN -4	11:1055
10	*See* BNL-NCS-36954	E 1.99:	DE86001167	MN -4	11:1056
11	*See* BNL-NCS-36955	E 1.99:	DE86001168	MN -4	11:1057
12	*See* BNL-NCS-36966	E 1.99:	DE86001166	MN -4	11:1131
14	*See* BNL-NCS-36962	E 1.99:	DE86001745	MN -34C	11:1687
18	*See* BNL-NCS-36964	E 1.99:	DE86001188	MN -4	11:1135
CONF-850902-	(2. international symposium on environmental degradation of materials in nuclear power systems--water reactors, Monterey, CA, USA, 9-12 Sep 1985)				
5	*See* PNL-SA-13101	E 1.99:	DE86001673	MN -80	11:571
CONF-850903-	(International topical meeting on computer applications for nuclear power plant operation and control, Pasco, WA, USA, 8-12 Sep 1985)				
22	*See* UCRL-93293	E 1.99:	DE86000740	MN -80	11:576
CONF-850920-	(9. international conference on magnet technology, Zurich, Switzerland, 9-13 Sep 1985)				
3	*See* LBL-20054	E 1.99:	DE86000604	MN -38	11:1164
5	*See* BNL-37011	E 1.99:	DE86001736	MN -28	11:1217
6	NTIS, PC A02; 3		DE86001355	MN -20b	11:1877
CONF-850925-	(3. international symposium on radiation physics, Ferrara, Italy, 30 Sep-4 Oct 1985)				
1	*See* LA-UR-85-3455	E 1.99:	DE86000797	MN -41	11:1255
CONF-850927-	(12. European conference on controlled fusion and plasma physics, Budapest, Hungary, 2-6 Sep 1985)				
7	*See* DOE/ET/51013-T157	E 1.99:	DE86001109	MN -20	11:1816
8	*See* LRP-267/85		DE86900009	MN -20	11:1840
CONF-850931-	(International seminar on costs and financing of nuclear power plants in developing countries, Vienna, Austria, 9-12 Sep 1985)				
1	*See* PNL-SA-13392		DE85018525	MN -83	11:167
CONF-850942-	(190. American Chemical Society national meeting, Chicago, IL, USA, 8-13 Sep 1985)				
27	*See* LA-UR-85-3234	E 1.99:	DE86000770	MN -34D	11:1633
31	*See* BNL-37078	E 1.99:	DE86001739	MN -34C	11:1658
32	*See* BNL-NCS-36975	E 1.99:	DE85017843	MN -34C	11:1629
CONF-850944-	(Muskoka conference: international symposium on acidic precipitation, Toronto, Ontario, Canada, 15-20 Sep 1985)				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001796	MN -11	11:1288
CONF-850953-	(3. symposium on containment of underground nuclear explosions, Idaho Falls, ID, USA, 10-12 Sep 1985)				
10	*See* UCRL-92419	E 1.99:	DE86001573	MN -35	11:1280
11	*See* UCRL-93326	E 1.99:	DE86001649	MN -35	11:1281
12	*See* UCRL-92399	E 1.99:	DE86001579	MN -11	11:1272
13	*See* UCRL-93405	E 1.99:	DE86001650	MN -35	11:1282
CONF-850956-	(6. international free-electron laser conference, Tahoe City, CA, USA, 8-13 Sep 1985)				
1	*See* LA-UR-85-3176	E 1.99:	DE86000781	MN -34	11:1238
2	*See* LA-UR-85-3164	E 1.99:	DE86000783	MN -28	11:1225
CONF-850963-	(International seminar on finite element and allied methods for reactor physics and shielding calculations, London, UK, 18-20 Sep 1985)				
1	*See* LA-UR-85-3276	E 1.99:	DE86000761	MN -32	11:1783
CONF-8509121-	(7. annual DOE LLWMP participants information meeting, Las Vegas, NV, USA, 10-13 Sep 1985)				
12	*See* PNL-SA-13375		TI85018523	MN -70B	11:217
13	*See* DP-MS-85-91	E 1.99:	DE85018531	MN -70B	11:1323
17	*See* BNL-NUREG-37071		TI86001738	MN -70B	11:208
18	*See* BNL-NUREG-37070		TI86001731	MN -70B	11:175
19	*See* MLM-3297(OP)	E 1.99:	DE86001755	MN -70	11:188
21	*See* BNL-NUREG-37068		TI86001729	MN -70B	11:174
CONF-8509142-	(Geothermal program review, Washington, DC, USA, 11-12 Sep 1985)				
4	*See* LA-UR-85-3333	E 1.99:	DE86000817	MN -66a	11:429
5	*See* LA-UR-85-3334	E 1.99:	DE86000815	MN -66a	11:430
7	*See* BNL-36933	E 1.99:	DE86001183	MN -66d	11:427
CONF-8509146-	(4. international conference on superoxide and superoxide dismutase, Rome, Italy, 1-6 Sep 1985)				
2	*See* BNL-36894	E 1.99:	DE86001204	MN -48	11:1124
CONF-8509147-	(ACTINIDES '85, Aix-en-Provence, France, 1-6 Sep 1985)				
9	*See* LA-UR-85-3143	E 1.99:	DE86000786	MN -25	11:891
CONF-8509152-	(Information crossroads of the 80's, Washington, DC, USA, 8-13 Sep 1985)				
1	*See* UCRL-92975	E 1.99:	DE85016944	MN -21	11:144
CONF-8509153-	(2. SP-100 program integration meeting, Denver, CO, USA, 17-19 Sep 1985)				
4	*See* LA-UR-85-3341	E 1.99:	DE86000813	MN -80	11:588
CONF-8509162-	(3. European workshop on problems in the numerical modeling of plasmas, Varenna, Italy, 10-13 Sep 1985)				
3	*See* LRP-275/85		DE86900010	MN -20	11:1843
4	*See* LRP-268/85		DE86900008	MN -20	11:1841
5	*See* LRP-269/85		DE86900007	MN -20	11:1842

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6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001350	MN -20	11:1815
CONF-8509168-	(Electron microscopy and analysis group conference, Newcastle-Upon-Tyne, England, 2-5 Sep 1985)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018463	MN -25	11:1020
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018464	MN -25	11:1021
CONF-8509169-	(Specialist workshop on iodine chemistry in reactor safety organization for economic cooperation and development, Harwell, England, 9-12 Sep 1985)				
1	*See* SAND-85-2131C		TI86000426	MN -80	11:747
CONF-8509173-	(2. international symposium on the synthesis and application of isotopically labeled compounds, Kansas City, MO, USA, 3-6 Sep 1985)				
2	*See* LA-UR-85-3180	E 1.99:	DE86000780	MN -4	11:1095
CONF-8509177-	(24. colloquium spectroscopicum internationale, Garmisch-Partenkirchen, F.R. Germany, 23 Sep 1985)				
1	*See* PNL-SA-13306	E 1.99:	DE85018527	MN -4	11:1067
CONF-8509179-	(4. semi-annual meeting of the softool user's group, Santa Barbara, CA, USA, 30 Sep 1985)				
1	*See* LA-UR-85-3129	E 1.99:	DE86000788	MN -32	11:1936
CONF-8509180-	(International Atomic Energy Agency (IAEA) advisory group meeting on atomic data for fusion plasma modelling, Vienna, Austria, 18-20 Sep 1985)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001353	MN -20	11:1542
CONF-8509181-	(8. thermosense conference, Cambridge, MA, USA, 16-20 Sep 1985)				
1	*See* MLM-3296(OP)	E 1.99:	DE86001757	MN -38	11:1269
CONF-851003-	(Conference on coal science, Sydney, Australia, 28 Oct-1 Nov 1985)				
11	*See* IS-M-557	E 1.99:	DE85017345	MN -90a	11:42
CONF-851007-	(3. international meeting on reactor thermal hydraulics, Newport, RI, USA, 15-18 Oct 1985)				
6	*See* LA-UR-85-946		TI85010105	MN -78	11:700
13	*See* BNL-NUREG-37037		TI86000630	MN -78	11:595
CONF-851019-	(International symposium on source term evaluation for accident conditions, Columbus, OH, USA, 28 Oct-1 Nov 1985)				
1	*See* IAEA-SM-281/41	E 1.99:	DE85018064	MN -78	11:687
2	NTIS, PC A02/MF A01 - GPO		TI86001345	MN -78	11:609
CONF-851061-	(Clean coal technologies conference, Arlington, VA, USA, 7-8 Oct 1985)				
1	*See* DOE/FE/60181-140	E 1.99:	DE86001131	MN -90	11:77
CONF-851068-	(10. international symposium on polynuclear aromatic hydrocarbons, Columbus, OH, USA, 21-23 Oct 1985)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001618	MN -48	11:1444
CONF-851097-	(IEEE symposium, San Francisco, CA, USA, 23-25 Oct 1985)				
2	*See* EGG-10282-2068	E 1.99:	DE86001103	MN -41	11:1251
CONF-8510151-	(28. Oak Ridge National Laboratory conference on analytical chemistry, Knoxville, TN, USA, 1-3 Oct 1985)				
4	*See* K/PS-5061	E 1.99:	DE86000522	MN -41	11:1214
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001335	MN -4	11:1022
7	*See* LA-UR-85-3444	E 1.99:	DE86000801	MN -4	11:1030
8	*See* LA-UR-85-3326	E 1.99:	DE86000819	MN -4	11:1029
10	*See* PNL-SA-13253	E 1.99:	DE86001674	MN -4	11:1032
CONF-8510158-	(Two phase combustion, numerical modelling of combustion processes: general combustion topics, Davis, CA, USA, 21-22 Oct 1985)				
2	*See* UCRL-93362	E 1.99:	DE86001560	MN -4	11:136
CONF-8510159-	(2. international conference on acoustic emission, Lake Tahoe, NV, USA, 28 Oct-1 Nov 1985)				
1	NTIS, PC A02/MF A01 - GPO		TI85014970	MN -78	11:477
CONF-8510161-	(Artificial intelligence in engineering conference, Washington, DC, USA, 21-23 Oct 1985)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018455	MN -79m	11:575
CONF-8510164-	(Advanced management of radiation accidents, Albuquerque, NM, USA, 3 Oct 1985)				
1	*See* SAND-85-2185C	E 1.99:	DE86000432	MN -41	11:1435
CONF-8510165-	(6. JOWOG meeting, Aldermaston, England, 7-11 Oct 1985)				
1	*See* SAND-85-1936C	E 1.99:	DE86001320	MN -41	11:1259
2	*See* SAND-85-2126C	E 1.99:	DE86001265	MN -21	11:1850
3	*See* SAND-85-2154C	E 1.99:	DE86001622	MN -28	11:1221
CONF-8510169-	(Low-level waste siting and characterization meeting, Paris, France, 1-3 Oct 1985)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001347	MN -70B	11:177
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001346	MN -70B	11:178
CONF-8510170-	(Laser welding and laser surface treatment clinic, Detroit, MI, USA, 29-31 Oct 1985)				
1	*See* SAND-85-1523C	E 1.99:	DE86000863	MN -25	11:956
CONF-8510171-	(Solid modeling '85: making CAD/CAM pay back, San Francisco, CA, USA, 6-8 Oct 1985)				
1	*See* BDX-613-3366	E 1.99:	DE86000528	MN -32	11:1932

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CONF-8510172-	(3. international conference and workshop on radiative properties of hot dense matter, Williamsburg, VA, USA, 14-18 Oct 1985)				
1	*See* LA-UR-85-3382	E 1.99:	DE86000806	MN -34C	11:1839
CONF-851102-	(11. symposium on engineering problems in fusion research, Austin, TX, USA, 18-22 Nov 1985)				
1	*See* LA-UR-85-3194	E 1.99:	DE86000778	MN -20b	11:1891
CONF-851115-	(American Nuclear Society winter meeting, San Francisco, CA, USA, 10-15 Nov 1985)				
20	*See* DP-MS-85-58	E 1.99:	DE85018520	MN -70	11:182
23	*See* HEDL-SA-3339-FP	E 1.99:	DE85018475	MN -79	11:586
24	*See* HEDL-SA-3334	E 1.99:	DE85018493	MN -79	11:585
CONF-851117-	(International symposium on emergency planning and preparedness for nuclear facilities, Rome, Italy, 4-8 Nov 1985)				
1	*See* UCRL-92509	E 1.99:	DE86001576	MN -41	11:1317
CONF-851123-	(American Institute of Chemical Engineers annual winter meeting, Chicago, IL, USA, 10-14 Nov 1985)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001794	MN -90i	11:766
CONF-851125-	(American Society of Mechanical Engineers winter annual meeting, Miami, FL, USA, 17-21 Nov 1985)				
1	*See* SAND-85-0225C	E 1.99:	DE85010671	MN -38	11:1172
13	*See* BNL-37027	E 1.99:	DE86000629	MN -25	11:870
CONF-851160-	(Air Pollution Control Association Pacific Northwest international section annual meeting, Calgary, Canada, 13-15 Nov 1985)				
1	*See* UCRL-92663	E 1.99:	DE86001580	MN -11	11:1454
CONF-851161-	(GOMAC conference, Orlando, FL, USA, 5-7 Nov 1985)				
1	*See* SAND-85-1484C	E 1.99:	DE85014463	MN -38	11:1205
CONF-851164-	(CASA/SME autofact '85, Detroit, MI, USA, 4-7 Nov 1985)				
3	*See* BDX-613-3374	E 1.99:	DE86001296	MN -32	11:1933
CONF-851174-	(32. national vacuum symposium and topical conference, Houston, TX, USA, 19-22 Nov 1985)				
7	*See* LA-UR-85-3163	E 1.99:	DE86000784	MN -21	11:1890
10	*See* LA-UR-85-3253	E 1.99:	DE86000765	MN -4	11:1118
11	*See* PFC/JA-85-29	E 1.99:	DE86001544	MN -20	11:1847
CONF-851177-	(7. symposium on turbulence and diffusion of the AMS, Boulder, CO, USA, 12-15 Nov 1985)				
1	*See* LA-UR-85-2745	E 1.99:	DE85015727	MN -11	11:1283
CONF-8511104-	(Magnetism and magnetic materials conference, San Diego, CA, USA, 27-30 Nov 1985)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018412	MN -25	11:876
CONF-8511105-	(Association of SYSTEM 2000 users for technical exchange (ASTUTE), Phoenix, AZ, USA, 5-7 Nov 1985)				
1	*See* SAND-85-2040C	E 1.99:	DE86000433	MN -38	11:1154
CONF-851217-	(Materials Research Society meeting, Boston, MA, USA, 2-7 Dec 1985)				
1	*See* SAND-84-1188C	E 1.99:	DE85012348	MN -25	11:1005
CONF-851238-	(International conference on infrared and millimeter waves, Lake Buena Vista, FL, USA, 8-13 Dec 1985)				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001790	MN -90	11:1266
CONF-860604-	(International symposium on the packaging and transport of radioactive materials (PATRAM '86), Davos, Switzerland, 16-20 Jun 1986)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001337	MN -71	11:152
COO-					
2383-0112	*See* UIUCDCS-R-85-1225	E 1.99:	DE86001404	MN -32	11:1945
CRC-					
542	*See* AD-A-156773/4/XAB				11:853
CRIEPI-E-					
284003	Central Research Institute of Electric Power Industry, Tokyo, Japan				11:4
CRN-PN-					
83-17	NTIS (US Sales Only), PC A11/MF A01		DE85752841	MN -34C	11:1732
84-02	NTIS (US Sales Only), PC A03/MF A01		DE85752927	MN -34C	11:1733
CT-					
79-009	*See* DOE/R1/10065-T1	E 1.99:	DE86000370	MN -59A	11:419
79-012	*See* DOE/R1/10060-T1		DE86000390	MN -59B	11:379
103-04	*See* PB-85-221547/XAB				11:1297
114-21A	*See* PB-85-220796/XAB				11:1296
116-15A	*See* PB-85-219947/XAB				11:1402
DAS-					
96	*See* CEA-CONF-7652		DE85752830	MN -79	11:596
98	*See* CEA-CONF-7654		DE85752834	MN -78	11:598
99	*See* CEA-CONF-7655		DE85752835	MN -78	11:599
102	*See* CEA-CONF-7658		DE85752817	MN -78	11:600
103	*See* CEA-CONF-7659		DE85752818	MN -78	11:601
104	*See* CEA-CONF-7660		DE85752831	MN -80	11:602
105	*See* CEA-CONF-7661		DE85752832	MN -80	11:1307
115	*See* CEA-CONF-7841		DE85752888	MN -80	11:605
119	*See* CEA-CONF-7843		DE85752889	MN -78	11:606

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120	*See* CEA-CONF-7844		DE85752887	MN -80	11:530
126	*See* CEA-CONF-7845		DE85752885	MN -80	11:471
DES-					
74-12	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001835	MN -11	11:459
DESY-					
85-011	NTIS (US Sales Only), PC A02/MF A01		DE85752016	MN -34D	11:1583
85-016	NTIS (US Sales Only), PC A02/MF A01		DE85752713	MN -28	11:995
85-018	NTIS (US Sales Only), PC A02/MF A01		DE85752131	MN -34D	11:1570
85-021	NTIS (US Sales Only), PC A02/MF A01		DE85752091	MN -34D	11:1571
85-029	NTIS (US Sales Only), PC A03/MF A01		DE85752134	MN -34D	11:1572
85-039	NTIS (US Sales Only), PC A02/MF A01		DE85752697	MN -34D	11:1573
DOE-					
010	*See* DOE/NBM-5017991	E 1.99:	DE85017991	MN -83	11:147
DOE/BC/10811-					
1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85000144	STD -92	11:90
DOE/BP-					
515	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002017	MN -13	11:767
545	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002018	MN -13	11:293
548	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001917	MN -11	11:294
549	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002022	MN -11	11:295
DOE/BP/11286-					
1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001700	MN -61A	11:301
DOE/BP/11902-					
2	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002024	MN -11	11:1353
DOE/BP/12737-					
1	NTIS, PC A25/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002023	MN -11	11:1354
2	NTIS, PC A21/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001934	MN -11	11:1355
DOE/BP/29182-					
15	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018284	MN -60	11:440
16	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018285	MN -60	11:441
DOE/CE-					
0037/ 1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86001591	STD -95d	11:804
DOE/CE/29999-					
T1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001703	MN -95	11:774
DOE/CE/40544-					
T1	NTIS, PC A17/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000009	MN -95f	11:835
DOE/CE/40635-					
2	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000210	STD -93	11:798
DOE/CE/40658-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001860	MN -95e	11:1361
DOE/CE/40732-					
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001105	MN -95f	11:763
DOE/CH/10223-					
T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001157	MN -95d	11:805
DOE/CS/30529-					
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000731	MN -59B	11:376
DOE/CS/40381-					
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001701	MN -61E	11:786
DOE/CS/40419-					
8	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99:	DE86001926	MN -95f	11:836
10	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001925	STD -95f	11:837
DOE/CS/50006-					
2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017008	STD -96	11:854
DOE/CS/54209-					
26	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017585	STD -96	11:858
27-Vol.2	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017587	STD -96	11:859
28	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017588	STD -96	11:860
DOE/CS/69129-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001822	MN -95d	11:806
DOE/DF-					
0001/ 16	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000051	STD -16	11:230
DOE/DP/40124-					
35	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001306	MN -21	11:1878
DOE/EIA-					
0035(85/ 07)	NTIS, PC A06/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86002467	MN -98	11:785
0109(85/ 08)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86002082	MN -98B	11:107
0121(85/ 2Q)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86001827	MN -98A	11:80
0130(85/ 08)	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86001830	MN -98C	11:125
0145(84)	NTIS, PC A10/MF A01; 1 - GPO		DE86001920	MN -98C	11:126
0202(85/ 3Q) 2	NTIS, PC A05/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86001828	MN -98	11:777
0216(84)	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86000658	MN -98B	11:86
0219(84)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86001829	MN -98	11:108
0226(85/ 07)	NTIS, PC A03/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86001693	MN -98E	11:782
0467	NTIS, PC A14/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86002042	MN -98B	11:87
0477	NTIS, PC A08/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86001141	MN -51	11:163
0478(84)	NTIS, PC A08/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86002041	MN -98F	11:164
0479	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001921	MN -98	11:453
0480	NTIS, PC A09/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86001922	MN -98	11:764
DOE/EIS-					
0005-DS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001833	MN -11	11:460
0048-DS-1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001834	MN -11	11:461
0099-F-Vol.1	NTIS, PC A17/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018030	MN -70A	11:220
0099-F-Vol.2	NTIS, PC A20/MF AA01; 1 (GPO Dep.)	E 1.99:	DE85018031	MN -70A	11:221

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DOE/ER-0046/22	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001638	STD -20c	11:1879
0143/3	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE86002089	STD -25	11:866
0144/3	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85008925	STD -05	11:1011
0145/3	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001832	STD -11	11:1471
0251	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE86001222	MN -13	11:1927
DOE/ER/02220-14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001840	MN -34D	11:1584
DOE/ER/02504-437	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001896	MN -28	11:1228
DOE/ER/03244-117	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001839	MN -34D	11:1637
DOE/ER/04310-T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001635	MN -48	11:302
DOE/ER/04694-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001853	MN -34A	11:1543
DOE/ER/04972-T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000878	MN -70	11:1496
DOE/ER/05490-69	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001326	MN -34	11:1601
DOE/ER/10332-15	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001659	MN -34C	11:1638
DOE/ER/10419-4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001955	MN -34C	11:1734
DOE/ER/10578-3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001586	MN -34A	11:1544
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000346	MN -34A	11:1545
DOE/ER/10713-4B	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001656	MN -34D	11:1574
DOE/ER/10722-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001631	MN -4	11:1093
DOE/ER/10725-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001630	MN -80	11:584
DOE/ER/10742-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001954	MN -28	11:1229
DOE/ER/10763-4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001220	MN -11	11:1493
DOE/ER/10958-4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001881	MN -25	11:877
T2	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99:	DE86002107	MN -25	11:878
DOE/ER/13107-3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001804	MN -48	11:1367
DOE/ER/13147-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001952	MN -34	11:1934
DOE/ER/13164-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000315	MN -38	11:1177
DOE/ER/13187-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001625	MN -48	11:303
DOE/ER/13248-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000227	MN -48	11:1398
DOE/ER/13340-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002147	MN -25	11:1059
DOE/ER/40012-01	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001548	MN -34B	11:1505
DOE/ER/40033-90	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001629	MN -34D	11:1249
DOE/ER/40152-1	American Institute of Physics, 335 East 45th St., New York, NY 10017		TI85015085	ND -34D	11:1575
DOE/ER/45163-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000545	MN -25	11:879
DOE/ER/53104-T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018047	STD -20g	11:1880
DOE/ER/60073-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001852	MN -48	11:1408
DOE/ER/60242-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001132	MN -11	11:1319
DOE/ER/60243-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001549	MN -48	11:1326
DOE/ER/60292-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001847	MN -11	11:1289
DOE/ER/70068-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000234	MN -4	11:1060
DOE/ER/70277-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000333	MN -4	11:1125
DOE/ET/10069-T117	NTIS (US Sales Only), PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000538	STD -90d	11:5
DOE/ET/10393-1904-Vol.2	NTIS, PC A22/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013707	STD -90e	11:75
1905-Vol.2	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013687	STD -90e	11:76
DOE/ET/10815-107	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000695	STD -90g	11:790

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
DOE/ET/15602-T16	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000992	MN -90g	11:791
DOE/ET/20111-T1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000844	MN -59A	11:417
T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000843	MN -59A	11:418
DOE/ET/34032-1	NTIS (US Sales Only), PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000224	STD -78	11:610
DOE/ET/51009-T2	Massachusetts Institute of Technology, Cambridge, MA 02142, $9.95		TI86001619	ND -20	11:1811
DOE/ET/51013-155	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001110	MN -20b	11:1881
159	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002001	MN -20	11:1882
T5	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001476	MN -20	11:1883
T157	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001109	MN -20	11:1816
DOE/ET/53016-86	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013664	STD -20g	11:1817
88	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001227	STD -20f	11:1818
DOE/ET/53088-184	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000858	MN -20d	11:1819
201	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000236	MN -20g	11:1820
205	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001783	MN -20a	11:1821
208	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001784	MN -20a	11:1822
DOE/ET/53193-2-276	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001678	MN -20	11:1823
DOE/EV/01105-316	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000850	MN -37	11:1250
317	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000849	MN -41	11:1409
320	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000845	MN -34C	11:1774
DOE/EV/03333-T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001626	MN -48	11:1370
DOE/EV/03861-50	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001892	MN -34A	11:996
DOE/EV/10256-T4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001163	MN -88	11:62
T5	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001212	MN -11	11:55
DOE/EV/10363-7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001891	MN -48	11:1138
8	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001889	MN -48	11:1139
DOE/EV/10726-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001599	MN -90i	11:82
DOE/EV/70024-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000549	MN -11	11:1334
DOE/FE/60181-140	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001131	MN -90	11:77
1845	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002156	STD -90	11:1
DOE/ID/12079-128	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002008	MN -66a	11:422
DOE/ID/12307-1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001550	MN -66	11:423
DOE/ID/12471-T1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001803	MN -66	11:420
DOE/ID/12537-1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002297	MN -25	11:972
DOE/JPL-954527-27/ 85	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001309	STD -63b	11:304
DOE/MA-0195	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002080	STD -13	11:1929
DOE/MC/16518-T1-Vol.1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017055	STD -90c	11:6
T1-Vol.2	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017056	STD -90c	11:7
T1-Vol.3	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017057	STD -90c	11:78
DOE/MC/21108-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001295	MN -90i	11:8
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001588	MN -90i	11:46
DOE/METC-85/ 4022	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85013612	MN -90	11:69
85/ 4028	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85013601	MN -38	11:1151
85/ 4029	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85013609	MN -4	11:1061
85/ 4030	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85013610	MN -34	11:1546
DOE/MI/01010-T1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE85014748	MN -96	11:832
DOE/NASA/0167-9	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001478	MN -96	11:855
DOE/NASA/20320-66	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001613	STD -60	11:442
DOE/NASA/50194-43	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85017352	STD -96	11:856
DOE/NBM-5017991	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017991	MN -83	11:147
5018246	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018246	MN -80	11:531
6001405	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001405	MN -70B	11:179
6001545	NTIS, PC A03/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86001545	MN -98	11:113

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DOE/NV/10162-20	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001456	MN -11	11:1322
DOE/OR/20722-70	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001223	STD -70A	11:222
71	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001440	MN -70B	11:180
DOE/OR/20948-T1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013510	MN -98	11:762
DOE/OR/21389-7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001947	MN -61	11:287
DOE/OR/21390-7	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001949	MN -61	11:787
8	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001948	MN -61	11:788
DOE/OR/21400-T179	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85018260	MN -13	11:778
T196	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001351	MN -20	11:1884
DOE/PC/50797-T11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001313	MN -90a	11:1062
DOE/PC/50810-T11	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018269	STD -90a	11:260
DOE/PC/60015-30	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001317	MN -90d	11:36
DOE/PC/60045-T7	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018268	STD -90d	11:70
DOE/PC/60264-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018298	MN -90i	11:462
DOE/PC/60787-8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001713	MN -90d	11:11
DOE/PC/60804-T8	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000197	MN -90d	11:1094
DOE/PC/70006-T4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002049	MN -90d	11:38
DOE/PC/70796-5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001764	MN -90a	11:71
DOE/PC/70799-T3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001266	MN -90d	11:39
DOE/PC/70801-2	NTIS, PC A02; 3		DE86000553	MN -90d	11:12
DOE/PC/70809-T3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001104	MN -90	11:40
DOE/PC/70812-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000986	MN -90d	11:13
DOE/PC/70814-1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002328	MN -90d	11:14
DOE/PC/81504-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002072	MN -90a	11:72
DOE/PC/81510-T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85017230	MN -90e	11:79
DOE/PE/17056-T5	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001138	MN -41	11:1469
DOE/PE/72013-1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85014694	STD -96	11:104
DOE/PE/77015-T1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001311	MN -05	11:779
DOE/PETC/TR-86/ 1	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001861	STD -90d	11:15
DOE/R0/00036-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000467	MN -59B	11:377
DOE/R0/00070-T1	NTIS, PC A03; 3		DE86000462	MN -60	11:443
DOE/R0/00454-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000452	MN -96	11:863
DOE/R0/01238-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000492	MN -95	11:838
DOE/R0/01318-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000487	MN -59	11:404
DOE/R1/10007-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000392	MN -61D	11:839
DOE/R1/10039-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000385	MN -59B	11:378
DOE/R1/10046-T1	NTIS, PC A03; 3		DE86000388	MN -61D	11:1209
DOE/R1/10059-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000356	MN -59B	11:305
DOE/R1/10060-T1	NTIS, PC A02; 3		DE86000390	MN -59B	11:379
DOE/R1/10065-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000370	MN -59A	11:419
DOE/R1/10342-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000389	MN -95f	11:840
DOE/R1/10345-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000371	MN -60	11:444
DOE/R1/10385-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000340	MN -59A	11:380

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DOE/R1/10402-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000359	MN -95f	11:841
DOE/R1/10403-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000358	MN -59B	11:381
DOE/R1/10425-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000374	MN -59B	11:382
DOE/R1/21263-T1	NTIS, PC A03; 3		DE86000507	MN -95e	11:1208
DOE/R1/22238-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000380	MN -64	11:434
DOE/R1/22239-T1	NTIS, PC A03; 3		DE86000379	MN -59B	11:405
DOE/R1/23271-T1	NTIS, PC A02; 3		DE86000375	MN -61D	11:288
DOE/R1/23279-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE86000377	MN -59A	11:406
DOE/R1/23281-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000508	MN -61E	11:789
DOE/R1/25251-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000365	MN -64	11:436
DOE/R1/26232-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000363	MN -61A	11:289
DOE/R1/26235-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000364	MN -95d	11:807
DOE/R2/05015-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000516	MN -59B	11:383
DOE/R2/05016-T1	NTIS, PC A02; 3		DE86000506	MN -59A	11:384
DOE/R2/05031-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000503	MN -59B	11:385
DOE/R2/05033-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000499	MN -59A	11:386
DOE/R2/05040-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000502	MN -61	11:808
DOE/R2/05041-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000501	MN -60	11:445
DOE/R2/05063-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000500	MN -95e	11:851
DOE/R2/05146-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000482	MN -60	11:446
DOE/R2/05152-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000474	MN -61E	11:261
DOE/R2/05164-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000405	MN -59A	11:407
DOE/R2/05166-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000472	MN -64	11:435
DOE/R2/05173-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000480	MN -61E	11:284
DOE/R2/05182-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000483	MN -59A	11:387
DOE/R2/05280-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85015632	MN -96	11:864
DOE/R4/10353-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000587	MN -61	11:285
DOE/R9/50012-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000444	MN -59B	11:388
DOE/R9/50040-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000344	MN -60	11:447
DOE/RA/04934-2	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001434	STD -97e	11:292
DOE/RA/50013-T1	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017602	MN -96	11:81
DOE/RL-85-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001782	STD -85	11:153
DOE/SAN/12196-3	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86002007	MN -66a	11:1485
14	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002011	MN -66a	11:424
DOE/SF/01949-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000442	MN -61E	11:262
DOE/SF/10499-T74	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000661	MN -62a	11:359
T75S	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000688	MN -62a	11:360
T87S	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000653	MN -62a	11:361
T119	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000709	MN -62a	11:362
T120	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000710	MN -62a	11:363
T121	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000711	MN -62a	11:364
T139-Rev.	NTIS, PC A23/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000666	MN -62a	11:365
T141	McDonnell Douglas Astronautics Co., 5301 Bolsa Ave., Huntington, CA 92647		T186000698	ND -62a	11:366
T148	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000720	MN -62a	11:367
T152	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000681	MN -62a	11:368
T155	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000656	MN -62a	11:369
T163	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001393	MN -62a	11:370
T164	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001394	MN -62a	11:371

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T166	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001396	MN -62a	11:372
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000349	MN -61E	11:286
DOE/SF/11603-					
T1	Arthur J. Suosman, Box 549, Point Arena, CA		TI86001140	ND -05	11:765
DOE/SF/11607-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000471	MN -96	11:857
DOE/SF/11608-					
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000351	MN -95	11:842
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T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000469	MN -61E	11:263
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000470	MN -59B	11:389
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T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000337	MN -60	11:448
DOE/SF/11620-					
T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000352	MN -60	11:437
DOE/SF/11624-					
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000401	MN -66	11:433
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T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000402	MN -59B	11:390
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T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000865	MN -66	11:428
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2001	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018512	MN -70	11:181
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8200-R48	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE84010075	STD -80	11:543
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273-Vol.3	NTIS, PC A15/MF A01		DE85043333		11:792
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273-Vol.3	NTIS, PC A15/MF A01		DE85043333		11:796
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894	NTIS (US Sales Only), PC A02/MF A01; 1		DE86900159	MN -70	11:1261
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85-58	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018520	MN -70	11:182
85-91	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85018531	MN -70B	11:1323
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84-11-11	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001868	MN -11	11:1344
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80-262	NTIS, PC A02; 3		DE85018517	MN -11	11:183
84-742	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001962	MN -11	11:1445
85-552	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001968	MN -11	11:1308
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274	*See* CEA-CONF-7635		DE85752916	MN -79	11:512
275	*See* CEA-CONF-7636		DE85752915	MN -79	11:513
277	*See* CEA-CONF-7638		DE85752913	MN -79	11:514
278	*See* CEA-CONF-7639		DE85752912	MN -79	11:515
279	*See* CEA-CONF-7640		DE85752911	MN -79	11:516
280	*See* CEA-CONF-7641		DE85752908	MN -79	11:517
281	*See* CEA-CONF-7642		DE85752909	MN -79	11:518
282	*See* CEA-CONF-7643		DE85752910	MN -79	11:519
283	*See* CEA-CONF-7644		DE85752905	MN -79	11:520
284	*See* CEA-CONF-7645		DE85752906	MN -79	11:521
285	*See* CEA-CONF-7646		DE85752907	MN -79	11:522
287	*See* CEA-CONF-7648		DE85752903	MN -79	11:523
288	*See* CEA-CONF-7649		DE85752904	MN -79	11:524
289	*See* CEA-CONF-7650		DE85752898	MN -79	11:525
290	*See* CEA-CONF-7651		DE85752899	MN -79	11:526
291	*See* CEA-CONF-7633		DE85752900	MN -79	11:510
292	*See* CEA-CONF-7634		DE85752901	MN -79	11:511
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90	United Nations Economic Commission for Europe				11:63
91	United Nations Economic Commission for Europe				11:64
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85-03	*See* LBL-19348	E 1.99:	DE86000626	MN -95d	11:811
EGG-					
2294-Vol.4	*See* NUREG/CR-3633-Vol.4		TI86000039	MN -78	11:727
2374	*See* NUREG/CR-4141		TI86001823	MN -78	11:570
2397	*See* NUREG/CR-4272		TI86001565	MN -80	11:505
2409	*See* NUREG/CR-4345		TI86001854	MN -78	11:158
2411	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001945	STD -70	11:184
10282-2068	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001103	MN -41	11:1251
10282-2080	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002064	MN -11	11:110
EGG-EA-					
6775	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE86002326	MN -95e	11:290
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6956	NTIS, PC A02/MF A01 - GPO		TI85017488	MN -78	11:611
EPA-					
600/ 7-85-006	*See* TVA/OP/EDT-84/13		DE86900097	MN -90i	11:1301
600/ 8-85-006	*See* TVA/OP/EDT-84/37		DE86900143	MN -90d	11:51
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85/ 042	*See* PB-85-227502/XAB				11:495
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85/ 001	*See* PB-85-233393/XAB				11:1299
EPRI-AP-					
4162	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920023	ND -90f	11:454
4288	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920022	ND -60	11:449
EPRI-CS-					
4277-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920028	ND -90i	11:463
4279	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920027	ND -90i	11:455
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4301	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920026	ND -11	11:1472
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4266	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920021	ND -97	11:783
EPRI-EL-					
4186	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920025	ND -97	11:467
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4256	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920012	ND -93	11:259
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4111	*See* NUREG/CR-4166		TI86002085	MN -78	11:731
4222-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920019	ND -78	11:497
4264-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI85920894	ND -80	11:557
4272	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920020	ND -80	11:880
4274	NTIS, PC A04/MF A01 - Research Reports Center, Box 25425, Palo Alto, CA 94303 (GPO Dep.)	E 1.99:	DE86001597	MN -78	11:681
4287	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920017	ND -78	11:488
4297	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920018	ND -80	11:682
4298	*See* NUREG/CR-4376		TI86900109	MN -78	11:742
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76/ 1	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE85015765	MN -63b	11:306
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ERP/CRL-					
84-29	Department of Energy, Mines and Resources, Cape Breton, Nova Scotia (Canada). Cape Breton Coal Research Laboratory				11:65
84-30	Department of Energy, Mines and Resources, Cape Breton, Nova Scotia (Canada). Cape Breton Coal Research Laboratory				11:66
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84-136	Canada Centre for Mineral and Technology, Ottawa, Ontario				11:41
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143	*See* DOE/SAN/12196-3	E 1.99:	DE86002007	MN -66a	11:1485
159	*See* DOE/SAN/12196-14	E 1.99:	DE86002011	MN -66a	11:424
84001-TR	*See* DOE/ID/12079-128	E 1.99:	DE86002008	MN -66a	11:422
ETCA-					
84-R-032	NTIS (US Sales Only), PC A03/MF A01		DE85752845	MN -80	11:1275
EUR-					
8947-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -59A	11:391
9097-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities				11:1944
9354	Commission of the European Communities, Luxembourg			ND -80	11:683
9788-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -95d	11:809
9845-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -95d	11:810
9867-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities				11:308
EUR-CEA-FC-					
1251	NTIS (US Sales Only), PC A12/MF A01		DE85752813	MN -20f	11:1824
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77-6	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001837	MN -11	11:464
81-25	NTIS, PC A17/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001836	MN -11	11:1357

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1983-28	*See* STEV-VIND-83-37		DE85752733	MN -60	11:451
FHWA/RD-					
85/ 095	*See* BNL-36977		TI86001624	MN -25	11:981
FNAL-TM-					
1351	NTIS, PC A02/MF A01; 1		DE86000643	STD -28	11:1230
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142-1	NTIS (US Sales Only), PC A03/MF A01		DE85752870	MN -80	11:558
142-2	NTIS (US Sales Only), PC A02/MF A01		DE85752863	MN -78	11:489
142-3	NTIS (US Sales Only), PC A02/MF A01		DE85752872	MN -78	11:559
143-1	NTIS (US Sales Only), PC A02/MF A01		DE85752871	MN -78	11:490
143-2	NTIS (US Sales Only), PC A02/MF A01		DE85752848	MN -78	11:491
143-3	NTIS (US Sales Only), PC A02/MF A01		DE85752869	MN -78	11:684
146-7	NTIS (US Sales Only), PC A02/MF A01		DE85752868	MN -80	11:560
147-1	NTIS (US Sales Only), PC A02/MF A01		DE85752866	MN -78	11:492
147-2	NTIS (US Sales Only), PC A02/MF A01		DE85752865	MN -80	11:561
147-3	NTIS (US Sales Only), PC A02/MF A01		DE85752864	MN -80	11:562
147-4	NTIS (US Sales Only), PC A02/MF A01		DE85752867	MN -80	11:563
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4	NTIS (US Sales Only), PC A16/MF A01		DE85752881	MN -48	11:1371
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276	*See* DOE/ET/53193-2-276	E 1.99:	DE86001678	MN -20	11:1823
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1545	NTIS (US Sales Only), PC A06/MF A01		DE85752877	MN -48	11:1372
1570	NTIS (US Sales Only), PC A08/MF A01		DE85752876	MN -48	11:1410
1989	NTIS (US Sales Only), PC A04/MF A01		DE85752862	MN -25	11:881
2042	NTIS (US Sales Only), PC A06/MF A01		DE85752875	MN -86	11:148
FWS/OBS-					
80/ 40.20	NTIS, PC A05/MF A01		TI86900147	MN -11	11:1335
84/ 24	NTIS, PC A05/MF A01; 1		TI86900094	MN -11	11:1328
85(7.2)	NTIS, PC A08/MF A01		TI86900095	MN -11	11:1329
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226	*See* AD-469554/0/XAB				11:581
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17425	*See* SAND-84-7122	E 1.99:	DE86002102	STD -71	11:161
18070	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000827	STD -20d	11:1885
18113	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000311	MN -20	11:1825
GAO/RCED-					
85-11	US General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86900085	MN -41	11:685
85-80	US General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86900084	MN -98B	11:109
85-125	US General Accounting Office, Box 6015, Gaithersburg, MD 20760		TI86900089	MN -38	11:1152
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064	*See* ORNL/M-98		TI86001300	MN -78	11:744
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674	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001646	MN -38	11:1198
723	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000753	MN -41	11:1159
836	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001647	MN -41	11:1160
844	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001648	MN -38	11:1200
895	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001662	MN -25	11:1024
896	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001663	MN -28	11:1231
GKSS-					
84/ E/ 53	NTIS (US Sales Only), PC A03/MF A01		DE85752709	MN -80	11:564
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938	*See* BMI-1985-073		DE85752717	MN -80	11:593
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140	NTIS (US Sales Only), PC A12/MF A01		DE85752719	MN -80	11:686
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11/ 85	NTIS (US Sales Only), PC A02/MF A01		DE85752716	MN -48	11:1411
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1232	*See* GSF-11/85		DE85752716	MN -48	11:1411
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85-11	NTIS (US Sales Only), PC A07/MF A01		DE85752695	MN -34C	11:1689
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85-14	NTIS (US Sales Only), PC A06/MF A01		DE85752696	MN -28	11:1232
HEDL-					
7554	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001556	MN -79g	11:528
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3334	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018493	MN -79	11:585
3339-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018475	MN -79	11:586
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85-16	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86000881	STD -79Td	11:587
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85-8239	*See* PB-85-209914/XAB				11:1396

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79-005	*See* DOE/SF/10570-T1	E 1.99:	DE86000349	MN -61E	11:286
IAE-					
3826/ 7	NTIS (US Sales Only), PC A03/MF A01		DE85702731	MN -20	11:1826
3832/ 7	NTIS (US Sales Only), PC A02/MF A01		DE85702732	MN -20	11:1827
3840/ 6	NTIS (US Sales Only), PC A02/MF A01		DE85702733	MN -20	11:1828
3854/ 6	NTIS (US Sales Only), PC A02/MF A01		DE85702738	MN -20	11:1829
3860/ 7	NTIS (US Sales Only), PC A02/MF A01		DE85702734	MN -20	11:1830
3891/ 7	NTIS (US Sales Only), PC A03/MF A01		DE85702735	MN -20	11:1886
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IAEA-SM-					
275/ 56	*See* CEA-CONF-7841		DE85752888	MN -80	11:605
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80-001	*See* DOE/R0/00454-T1	E 1.99:	DE86000452	MN -96	11:863
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249-1984	NTIS (US Sales Only), PC A02/MF A01		DE85702767	MN -34C	11:1735
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108-1984	NTIS (US Sales Only), PC A03/MF A01		DE85702760	MN -34D	11:1576
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32-1984	NTIS (US Sales Only), PC A02/MF A01		DE85702777	MN -34C	11:1736
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32-603-Pt.1	NTIS (US Sales Only), PC A15/MF A01		DE85752878	MN -51	11:165
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IFSR-					
184-R	*See* DOE/ET/53088-184	E 1.99:	DE86000858	MN -20d	11:1819
201	*See* DOE/ET/53088-201	E 1.99:	DE86000236	MN -20g	11:1820
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IFTAR-LOP-					
47-1984	NTIS (US Sales Only), PC A03/MF A01		DE85702736	MN -20	11:1831
49-1984	NTIS (US Sales Only), PC A02/MF A01		DE85702737	MN -20	11:1832
IFTAR-NP-					
30-1984	NTIS (US Sales Only), PC A07/MF A01		DE85702720	MN -34A	11:1548
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83-30	NTIS (US Sales Only), PC A02/MF A01		DE85702744	MN -34D	11:1585
84-155	NTIS (US Sales Only), PC A02/MF A01		DE85702761	MN -34D	11:1577
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84-59	NTIS (US Sales Only), PC A02/MF A01		DE85702686	MN -34D	11:1604
84-79	NTIS (US Sales Only), PC A02/MF A01		DE85702747	MN -34D	11:1586
84-115	NTIS (US Sales Only), PC A02/MF A01		DE85702717	MN -34D	11:1605
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90	*See* PB-85-210037/XAB				11:56
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92-U	*See* NEANDC(J)-106-U		DE86900184	MN -34C	11:1634
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289	NTIS (US Sales Only), PC A08/MF A01		DE86780104	MN -78	11:688
290	NTIS (US Sales Only), PC A04/MF A01		DE86780020	MN -25	11:1185
291	NTIS (US Sales Only), PC A11/MF A01		DE86780018	MN -4	11:1025
293	NTIS (US Sales Only), PC A05/MF A01		DE86780037	MN -38	11:1178
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295	NTIS (US Sales Only), PC A08/MF A01		DE86780023	MN -25	11:882
297	NTIS (US Sales Only), PC A02/MF A01		DE86780024	MN -25	11:883
298	NTIS (US Sales Only), PC A20/MF A01		DE86780021	MN -25	11:884
299	NTIS (US Sales Only), PC A06/MF A01		DE86780039	MN -38	11:1161
300	NTIS (US Sales Only), PC A08/MF A01		DE86780040	MN -38	11:1162
301	NTIS (US Sales Only), PC A05/MF A01		DE86780022	MN -25	11:885
302	NTIS (US Sales Only), PC A08/MF A01		DE86780038	MN -38	11:689
INIS-mf-					
9345	NTIS (US Sales Only), PC A06/MF A01		DE86780014	MN -34C	11:1639
9346	NTIS (US Sales Only), PC A05/MF A01		DE86780016	MN -34C	11:1677
9354	NTIS (US Sales Only), PC A07/MF A01		DE86780026	MN -48	11:1414
9355	NTIS (US Sales Only), PC A06/MF A01		DE86780027	MN -48	11:1415
9363	NTIS (US Sales Only), PC A23/MF A01		DE86780041	MN -71	11:154
9364	NTIS (US Sales Only), PC A04/MF A01		DE86780019	MN -4	11:1141
9365	NTIS (US Sales Only), PC A03/MF A01		DE86780036	MN -48	11:1379
9366	NTIS (US Sales Only), PC A05/MF A01		DE86780028	MN -48	11:1416
9367	NTIS (US Sales Only), PC A06/MF A01		DE86780034	MN -48	11:1380
9368	NTIS (US Sales Only), PC A04/MF A01		DE86780029	MN -48	11:1417
9369	NTIS (US Sales Only), PC A05/MF A01		DE86780035	MN -48	11:1446
9375	NTIS (US Sales Only), PC A06/MF A01		DE86780015	MN -34C	11:1659
9383	NTIS (US Sales Only), PC A09/MF A01		DE86780087	MN -34C	11:1630
9385	NTIS (US Sales Only), PC A06/MF A01		DE86780085	MN -34D	11:1587
9742	NTIS (US Sales Only), PC A12/MF A01		DE85781598	MN -4	11:1027
9759	NTIS (US Sales Only), PC A20/MF A01		DE85781595	MN -34D	11:1631
9767	NTIS (US Sales Only), PC A11/MF A01		DE86780025	MN -11	11:1327
9901	NTIS (US Sales Only), PC A06/MF A01		DE86780042	MN -28	11:1632
9904	NTIS (US Sales Only), PC A02/MF A01		DE86780030	MN -48	11:223

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
9905	NTIS (US Sales Only), PC A04/MF A01		DE86780091	MN -25	11:1186
9910-Vol.1	NTIS (US Sales Only), PC A21/MF A01		DE86780088	MN -4	11:472
9910-Vol.2	NTIS (US Sales Only), PC A23/MF A01		DE86780089	MN -86	11:473
9926	NTIS (US Sales Only), PC A02/MF A01		DE86780084	MN -34A	11:1549
9946	NTIS (US Sales Only), PC A02/MF A01		DE85702723	MN -34A	11:1550
INIS-SU-					
305	NTIS (US Sales Only), PC A18/MF A01		DE86780086	MN -46	11:1779
IPNO-DRE-					
83-33	NTIS (US Sales Only), PC A02/MF A01		DE85752926	MN -28	11:1236
84-16	NTIS (US Sales Only), PC A02/MF A01		DE85752937	MN -37	11:1254
84-43	NTIS (US Sales Only), PC A02/MF A01		DE85752925	MN -34C	11:1683
85-02	NTIS (US Sales Only), PC A02/MF A01		DE85752936	MN -34C	11:1673
85-03	NTIS (US Sales Only), PC A02/MF A01		DE85752935	MN -34C	11:1684
85-04	NTIS (US Sales Only), PC A02/MF A01		DE85752933	MN -34C	11:1685
IPNO-GTA-					
84-14	NTIS (US Sales Only), PC A02/MF A01		DE85752934	MN -28	11:1237
IPNO-TH-					
83-33	NTIS (US Sales Only), PC A03/MF A01		DE85752919	MN -34C	11:1757
84-73	NTIS (US Sales Only), PC A02/MF A01		DE85752930	MN -34C	11:1651
84-77	NTIS (US Sales Only), PC A02/MF A01		DE85752929	MN -34C	11:1758
85-05	NTIS (US Sales Only), PC A02/MF A01		DE85752928	MN -34C	11:1759
IR-					
1151	*See* PB-85-222420/XAB				11:67
IRNE-					
156-1983	NTIS (US Sales Only), PC A02/MF A01		DE85702763	MN -46	11:1780
IS-M-					
557	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017345	MN -90a	11:42
IS-T-					
1124	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002110	MN -4	11:1063
1166	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002115	MN -4	11:973
1172	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002113	MN -4	11:1064
1175	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99:	DE86002111	MN -25	11:1065
1189	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99:	DE86002116	MN -4	11:1267
1223	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002108	MN -90b	11:73
ISN-					
84-34	NTIS (US Sales Only), PC A02/MF A01		DE85752932	MN -34C	11:1645
84-40	NTIS (US Sales Only), PC A02/MF A01		DE85752918	MN -34C	11:1760
84-42	NTIS (US Sales Only), PC A02/MF A01		DE85752921	MN -34C	11:1640
85-01	NTIS (US Sales Only), PC A02/MF A01		DE85752920	MN -34C	11:1667
ISPO-					
207	*See* SAND-83-2618	E 1.99:	DE86001681	MN -15	11:251
ITEF-					
25(1984)	NTIS (US Sales Only), PC A02/MF A01		DE85702687	MN -34D	11:1607
64(1984)	NTIS (US Sales Only), PC A02/MF A01		DE85702704	MN -34D	11:1798
ITEP-					
61(1984)	NTIS (US Sales Only), PC A02/MF A01		DE85702688	MN -34D	11:1608
71(1984)	NTIS (US Sales Only), PC A03/MF A01		DE85702689	MN -34D	11:1609
119(1984)	NTIS (US Sales Only), PC A03/MF A01		DE85702696	MN -34D	11:1610
ITF-					
83-56-R	NTIS (US Sales Only), PC A03/MF A01		DE85702697	MN -34D	11:1799
84-70-R	NTIS (US Sales Only), PC A03/MF A01		DE85702729	MN -34A	11:1790
84-132-R	NTIS (US Sales Only), PC A03/MF A01		DE85702739	MN -20	11:1833
IVL-B-					
746	NTIS (US Sales Only), PC A02/MF A01		DE85752729	MN -11	11:1290
754	NTIS (US Sales Only), PC A04/MF A01		DE85752735	MN -11	11:1291
JAERI-M-					
85-101	*See* NEANDC(J)-114/U		TI85902217	ND -34C	11:1657
85-138	*See* NEANDC(J)-115/U		TI86900107	ND -34C	11:1731
JINR-					
1-84	NTIS (US Sales Only), PC A03/MF A01		DE86780082	MN -34D	11:1565
E-2-84-126	NTIS (US Sales Only), PC A02/MF A01		DE85702699	MN -34D	11:1611
E-2-84-298	NTIS (US Sales Only), PC A02/MF A01		DE85702748	MN -34D	11:1589
E-2-84-331	NTIS (US Sales Only), PC A02/MF A01		DE85702749	MN -34D	11:1590
E-2-84-349	NTIS (US Sales Only), PC A02/MF A01		DE85702750	MN -34D	11:1591
E-2-84-572	NTIS (US Sales Only), PC A02/MF A01		DE85702751	MN -34D	11:1602
E-2-84-650	NTIS (US Sales Only), PC A02/MF A01		DE85702708	MN -34D	11:1612
E-2-84-720	NTIS (US Sales Only), PC A02/MF A01		DE85702718	MN -34D	11:1613
E-2-84-732	NTIS (US Sales Only), PC A02/MF A01		DE85702776	MN -34C	11:1761
E-2-84-777	NTIS (US Sales Only), PC A02/MF A01		DE85702709	MN -34D	11:1614
E-2-84-783	NTIS (US Sales Only), PC A02/MF A01		DE85702710	MN -34D	11:1615
E-2-85-56	NTIS (US Sales Only), PC A02/MF A01		DE85702711	MN -34D	11:1616
E-4-83-103	NTIS (US Sales Only), PC A02/MF A01		DE85702768	MN -34C	11:1674
E-4-84-117	NTIS (US Sales Only), PC A02/MF A01		DE85702769	MN -34C	11:1762
E-4-84-187	NTIS (US Sales Only), PC A02/MF A01		DE85702770	MN -34C	11:1730
E-14-84-339	NTIS (US Sales Only), PC A02/MF A01		DE85702730	MN -34A	11:890
E-17-84-9	NTIS (US Sales Only), PC A02/MF A01		DE85702698	MN -34D	11:1800
R-2-83-770	NTIS (US Sales Only), PC A02/MF A01		DE85702778	MN -34C	11:1763
R-2-84-86	NTIS (US Sales Only), PC A02/MF A01		DE85702702	MN -34D	11:1801
R-2-84-95	NTIS (US Sales Only), PC A02/MF A01		DE85702779	MN -34C	11:1641
R-2-84-122	NTIS (US Sales Only), PC A02/MF A01		DE85702752	MN -34D	11:1592
R-2-84-176	NTIS (US Sales Only), PC A02/MF A01		DE85702712	MN -34D	11:1617
R-2-84-329	NTIS (US Sales Only), PC A02/MF A01		DE85702753	MN -34D	11:1618
R-2-84-471	NTIS (US Sales Only), PC A02/MF A01		DE85702758	MN -34D	11:1619
R-2-84-557	NTIS (US Sales Only), PC A02/MF A01		DE85702754	MN -34D	11:1593

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R-2-84-591	NTIS (US Sales Only), PC A02/MF A01		DE85702700	MN -34D	11:1764
R-2-84-616	NTIS (US Sales Only), PC A02/MF A01		DE85702755	MN -34D	11:1594
R-2-84-617	NTIS (US Sales Only), PC A02/MF A01		DE85702756	MN -34D	11:1595
R-2-84-683	NTIS (US Sales Only), PC A02/MF A01		DE85702713	MN -34D	11:1620
R-2-84-698	NTIS (US Sales Only), PC A02/MF A01		DE85702757	MN -34D	11:1596
R-2-84-699	NTIS (US Sales Only), PC A02/MF A01		DE85702719	MN -34D	11:1621
R-2-84-716	NTIS (US Sales Only), PC A03/MF A01		DE85702759	MN -34D	11:1622
R-2-84-753	NTIS (US Sales Only), PC A03/MF A01		DE85702714	MN -34D	11:1623
R-2-84-803	NTIS (US Sales Only), PC A02/MF A01		DE85702701	MN -34D	11:1802
R-2-84-820	NTIS (US Sales Only), PC A02/MF A01		DE85702745	MN -34D	11:1597
R-2-84-836	NTIS (US Sales Only), PC A02/MF A01		DE85702715	MN -34D	11:1624
R-2-84-843	NTIS (US Sales Only), PC A02/MF A01		DE85702705	MN -34D	11:1803
R-2-85-10	NTIS (US Sales Only), PC A02/MF A01		DE85702716	MN -34D	11:1625
R-3-84-810	NTIS (US Sales Only), PC A02/MF A01		DE85702764	MN -46	11:1781
R-4-83-225	NTIS (US Sales Only), PC A02/MF A01		DE85702771	MN -34C	11:1765
R-4-84-215	NTIS (US Sales Only), PC A02/MF A01		DE85702780	MN -34C	11:1766
R-4-84-304	NTIS (US Sales Only), PC A02/MF A01		DE85702772	MN -34C	11:1767
R-4-84-399	NTIS (US Sales Only), PC A02/MF A01		DE85702773	MN -34C	11:1768
R-4-84-520	NTIS (US Sales Only), PC A02/MF A01		DE85702781	MN -34C	11:1652
R-4-84-642	NTIS (US Sales Only), PC A02/MF A01		DE85702722	MN -34A	11:1551
R-4-84-695	NTIS (US Sales Only), PC A02/MF A01		DE85702774	MN -34C	11:1675
R-4-84-727	NTIS (US Sales Only), PC A02/MF A01		DE85702690	MN -34D	11:1626
R-4-84-793	NTIS (US Sales Only), PC A02/MF A01		DE85702703	MN -34D	11:1804
R-4-85-18	NTIS (US Sales Only), PC A02/MF A01		DE85702746	MN -34D	11:1598
R-5-84-431	NTIS (US Sales Only), PC A02/MF A01		DE85702691	MN -34D	11:1599
R-5-84-719	NTIS (US Sales Only), PC A02/MF A01		DE85702692	MN -34D	11:1627
R-5-84-742	NTIS (US Sales Only), PC A02/MF A01		DE85702693	MN -34D	11:1805
R-14-84-612	NTIS (US Sales Only), PC A02/MF A01		DE85702726	MN -34A	11:997
R-14-84-707	NTIS (US Sales Only), PC A02/MF A01		DE85702721	MN -34A	11:1552
JPL-					
5101-18	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85015770	MN -63b	11:309
5101-29	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85015769	MN -63b	11:310
5101-37	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85015768	MN -63b	11:311
5101-52	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85015767	MN -63b	11:312
9950-1037	*See* DOE/CS/54209-26	E 1.99:	DE85017585	STD -96	11:858
9950-1038-Vol.2	*See* DOE/CS/54209-27-Vol.2	E 1.99:	DE85017587	STD -96	11:859
9950-1039	*See* DOE/CS/54209-28	E 1.99:	DE85017588	STD -96	11:860
JPL/D-					
5101-2	*See* ERDA/JPL/1012-76/1	E 1.99:	DE85015765	MN -63b	11:306
5101-5	*See* ERDA/JPL/1012-76/4	E 1.99:	DE85015771	MN -63b	11:307
Juel-					
1962	NTIS (US Sales Only), PC A07/MF A01		DE85752124	MN -38	11:1191
K/PS-					
1123	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018438	MN -12	11:768
5061	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000522	MN -41	11:1214
K-Trans-					
301	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001608	MN -4	11:1117
KFK-					
3806	NTIS (US Sales Only), PC A03/MF A01		DE85752213	MN -38	11:1201
3824	NTIS (US Sales Only), PC A04/MF A01		DE85752209	MN -32	11:1935
3873	NTIS (US Sales Only), PC A07/MF A01		DE85752708	MN -79p	11:699
3882	NTIS (US Sales Only), PC A04/MF A01		DE85752711	MN -80	11:456
3886	NTIS (US Sales Only), PC A03/MF A01		DE85752710	MN -70	11:186
3905	NTIS (US Sales Only), PC A05/MF A01		DE85752712	MN -70	11:187
3935	NTIS (US Sales Only), PC A05/MF A01		DE85752714	MN -15	11:231
3936	NTIS (US Sales Only), PC A03/MF A01		DE85752715	MN -11	11:1309
KFTI-					
83-25	NTIS (US Sales Only), PC A02/MF A01		DE85702740	MN -20	11:1834
KIYI-					
83-2	NTIS (US Sales Only), PC A02/MF A01		DE86780080	MN -25	11:999
83-4	NTIS (US Sales Only), PC A02/MF A01		DE86780081	MN -20	11:1838
83-22	NTIS (US Sales Only), PC A03/MF A01		DE85702724	MN -34A	11:1553
84-1	NTIS (US Sales Only), PC A03/MF A01		DE85702727	MN -34A	11:1782
LA-					
8772-MS	*See* NUREG/CR-2108		TI86000908	MN -77	11:717
8806-MS	*See* NUREG/CR-2061		TI86000892	MN -79	11:714
10445-MS	*See* NUREG/CR-4278	E 1.99:	TI86001251	MN -78	11:735
10478-MS	*See* NUREG/CR-4321		TI85017973	MN -83	11:224
10500-MS	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001238	STD -20d	11:1889
10510-M	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001232	MN -15	11:232
LA-tr-					
85-45	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001260	MN -25	11:971
85-48	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001257	MN -86	11:151
LA-UR-					
85-946	NTIS, PC A03/MF A01 - GPO		TI85010105	MN -78	11:700
85-2745	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85015727	MN -11	11:1283
85-2942	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000790	MN -28	11:1224
85-2985	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85017542	MN -48	11:1364
85-3113	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000789	MN -34A	11:1554
85-3129	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000788	MN -32	11:1936
85-3143	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000786	MN -25	11:891
85-3163	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000784	MN -21	11:1890
85-3164	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000783	MN -28	11:1225
85-3176	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000781	MN -34	11:1238

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85-3180	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000780	MN -4	11:1095
85-3194	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000778	MN -20b	11:1891
85-3195	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000777	MN -97c	11:753
85-3196	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000776	MN -97c	11:754
85-3199	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000775	MN -34D	11:1578
85-3232	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000772	MN -34B	11:1510
85-3234	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000770	MN -34D	11:1633
85-3237	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000769	MN -32	11:1806
85-3253	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000765	MN -4	11:1118
85-3268	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000763	MN -48	11:1365
85-3276	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000761	MN -32	11:1783
85-3313	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000754	MN -34D	11:1600
85-3314	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000755	MN -34B	11:1506
85-3326	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000819	MN -4	11:1029
85-3333	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000817	MN -66a	11:429
85-3334	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000815	MN -66a	11:430
85-3341	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000813	MN -80	11:588
85-3382	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000806	MN -34C	11:1839
85-3416	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000803	MN -34C	11:545
85-3444	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000801	MN -4	11:1030
85-3455	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000797	MN -41	11:1255
LBL-					
19160	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001483	MN -25	11:1791
19171	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000602	MN -28	11:1239
19246	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000619	MN -38	11:1163
19331	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001480	MN -34A	11:1555
19346	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000615	MN -41	11:1310
19348	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000626	MN -95d	11:811
19394	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000618	MN -28	11:1220
19726	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000622	MN -41	11:1311
19788	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85015132	MN -25	11:1792
19992	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000616	MN -34D	11:1579
20044	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000625	MN -25	11:892
20048	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86000609	MN -34A	11:1556
20050	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001421	MN -25	11:1066
20054	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000604	MN -38	11:1164
20086	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001484	MN -34C	11:1668
20155	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001997	MN -25	11:974
20163	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001401	MN -34C	11:1635
20174	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000621	MN -38	11:1165
20195	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001209	MN -34A	11:1557
LBL-PUB-					
3037	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86000627	MN -38	11:1202
LPC-					
84-21	NTIS (US Sales Only), PC A03/MF A01		DE85752074	MN -28	11:1256
LRP-					
267/ 85	NTIS (US Sales Only), PC A03/MF A01		DE86900009	MN -20	11:1840
268/ 85	NTIS (US Sales Only), PC A04/MF A01		DE86900008	MN -20	11:1841
269/ 85	NTIS (US Sales Only), PC A03/MF A01		DE86900007	MN -20	11:1842
275/ 85	NTIS (US Sales Only), PC A05/MF A01		DE86900010	MN -20	11:1843
LYCEN-					
8344	NTIS (US Sales Only), PC A06/MF A01		DE85752924	MN -37	11:1257
8345	NTIS (US Sales Only), PC A05/MF A01		DE85752923	MN -34C	11:1676
MA-					
79-002	*See* DOE/R1/10046-T1		DE86000388	MN -61D	11:1209
79-003	*See* DOE/R1/10059-T1	E 1.99:	DE86000356	MN -59B	11:305
80-010	*See* DOE/R1/10403-T1	E 1.99:	DE86000358	MN -59B	11:381
81-002	*See* DOE/R1/23281-T1	E 1.99:	DE86000508	MN -61E	11:789
81-013	*See* DOE/R1/23271-T1		DE86000375	MN -61D	11:288
81-015	*See* DOE/R1/23279-T1	E 1.99:	DE86000377	MN -59A	11:406
MAD/PH-					
230	*See* DESY-85-011		DE85752016	MN -34D	11:1583
MDC-G-					
8169-Rev.1	*See* DOE/SF/10499-T75S	E 1.99:	DE86000688	MN -62a	11:360
8181	*See* DOE/SF/10499-T87S	E 1.99:	DE86000653	MN -62a	11:361
8508-3-80	*See* DOE/SF/10499-T74	E 1.99:	DE86000661	MN -62a	11:359
9705-Bk.1-Sect.1	*See* DOE/SF/10499-T141		TI86000698	ND -62a	11:366
9705-Bk.1-Sect.6	*See* DOE/SF/10499-T152	E 1.99:	DE86000681	MN -62a	11:368
9705-Bk.2-Sect.4	*See* DOE/SF/10499-T148	E 1.99:	DE86000720	MN -62a	11:367
9705-Sect.8	*See* DOE/SF/10499-T155	E 1.99:	DE86000656	MN -62a	11:369
MDC-H-					
030	*See* DOE/SF/10499-T164	E 1.99:	DE86001394	MN -62a	11:371
0130-Vol.4-Sect.3	*See* DOE/SF/10499-T166	E 1.99:	DE86001396	MN -62a	11:372
ME-					
81-004	*See* DOE/R1/22238-T1	E 1.99:	DE86000380	MN -64	11:434
81-005	*See* DOE/R1/22239-T1		DE86000379	MN -59B	11:405
MIT-EL-					
84-017	Massachusetts Institute of Technology, Energy Lab., Cambridge, MA		TI85902102	MN -92	11:133
MITNPI-PA-					
002-ES	*See* PB-85-223030/XAB				11:475
MLM-					
2695	*See* NUREG/CR-0975		TI86000098	STD -15	11:236
3296(OP)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001757	MN -38	11:1269

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3297(OP)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001755	MN -70	11:188
3304	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002087	STD -70	11:189
MND-					
3193	*See* AD-460642/2/XAB				11:529
MRI/SOL-					
0201	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001274	MN -59A	11:392
0800-07	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001290	MN -59A	11:393
NASA-CR-					
174886	*See* DOE/NASA/0167-9	E 1.99:	DE86001478	MN -96	11:855
NASA-TM-					
86953	*See* DOE/NASA/50194-43	E 1.99:	DE85017352	STD -96	11:856
87109	*See* DOE/NASA/20320-66	E 1.99:	DE86001613	STD -60	11:442
NE-F-					
2-10-8-85	Performance Assurance Project Office, ORNL, Box Y, Bldg. 9204-1, Oak Ridge, TN 37831		TI86000185	ND -80	11:544
NEANDC(J)-					
106-U	NTIS (US Sales Only), PC A05/MF A01		DE86900184	MN -34C	11:1634
114/ U	JAERI-Information Div., Dept. of Technical Information, Tokai-mura, Naka-gun Ibaraki-ken, Japan		TI85902217	ND -34C	11:1657
115/ U	JAERI-Information Div., Dept. of Technical Information, Tokai-mura, Naka-gun, Ibaraki-ken, Japan		TI86900107	ND -34C	11:1731
NEDO-					
30967	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85016089	STD -78	11:701
NIIEFA-P-B-					
0635	NTIS (US Sales Only), PC A02/MF A01		DE85702742	MN -20	11:1892
NIOSH-					
84-116	NIOSH-Robert Taft Lab., 4676 Columbia Parkway, Cincinnati, OH 45226		TI85901684	MN -48	11:1447
NIPER-					
85	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99:	DE85000143	STD -92	11:91
NMERDI-					
2-73-4607	NTIS, PC A04/MF A01; 1 - NMERDI-Univ. of New Mexico, Suite M, 457 Washington, SE, Albuquerque, NM 87108		DE86900092	MN -60	11:450
NOAA-TM-ERL-ARL-					
135	*See* PB-85-212959/XAB				11:1293
136	*See* PB-85-212058/XAB				11:1292
NP-					
5902153	NTIS, PC A04/MF A01; 1		DE85902153	MN -79	11:770
6900110	DGGS Publications, 3601 C St., Anchorage, AK 99510		TI86900110	MN -11	11:1473
6900131	Missouri Dept. of Natural Resources, Box 176, Jefferson City, MO 65102		TI86900131	MN -96	11:833
6900148	Nebraska Energy Office, Box 95085, Lincoln, NE 68509		TI86900148	MN -98F	11:775
86770025	NTIS (US Sales Only), PC A09/MF A01; 1		DE86770025	MN -59A	11:812
86770026	NTIS (US Sales Only), PC A08/MF A01; 1		DE86770026	MN -48	11:1448
NUREG-					
0020-Vol.9-No.6	NTIS, PC A19/MF A01 - GPO		TI85902010	MN -80	11:538
0020-Vol.9-No.8	NTIS, PC A19/MF A01 - GPO		TI86900124	MN -80	11:771
0383-Vol.3-Rev.5	NTIS, PC A07/MF A01 - GPO		TI86900250	MN -71	11:155
0436-Rev.1-Suppl.1	NTIS, PC A03/MF A01 - GPO		TI86900072	MN -41	11:532
0525-Rev.1	NTIS, PC A07/MF A01 - GPO		TI86900078	MN -15	11:233
0540-Vol.7-No.8	NTIS, PC A99/MF A01 - GPO		TI86900155	MN -80	11:533
0748-Vol.5-No.7	NTIS, PC A16/MF A01 - GPO		TI86900086	MN -80	11:534
0750-Vol.22-No.1	NTIS, PC A09/MF A01 - GPO		TI85902224	MN -2	11:535
0837-Vol.5-No.2	NTIS, PC A10/MF A01 - GPO		TI86900115	MN -41	11:1312
1046-F	NTIS, PC A03/MF A01 - GPO		TI86900170	MN -70	11:190
1094-Final	NTIS, PC A14/MF A01 - GPO		TI86900116	MN -78	11:578
1155-Vol.1	NTIS, PC A03/MF A01 - GPO		TI85901966	MN -78	11:702
1155-Vol.3	NTIS, PC A02/MF A01 - GPO		TI85901968	MN -78	11:703
NUREG/CR-					
0150-Vol.3	NTIS, PC A05/MF A01 - GPO		TI86000924	MN -41	11:1313
0743	NTIS, PC A24/MF A01 - GPO		TI86000909	MN -11	11:1356
0849-Vol.2-No.4	NTIS, PC A03/MF A01 - GPO		TI86000967	MN -15	11:234
0849-Vol.3-No.1	NTIS, PC A02/MF A01 - GPO		TI86000182	MN -15	11:235
0975	NTIS, PC A03/MF A01; 1		TI86000098	STD -15	11:236
1048	NTIS, PC A11/MF A01 - GPO		TI86000125	MN -15	11:237
1117	NTIS, PC A09/MF A01 - GPO $6.00		TI86000898	MN -71	11:156
1122	NTIS, PC A03/MF A01 - GPO		TI86000150	MN -79p	11:704
1151	NTIS, PC A02/MF A01 - GPO		TI86000167	MN -41	11:1314
1233-Vol.3	NTIS, PC A15/MF A01 - GPO		TI86000137	MN -15	11:238
1233-Vol.4	NTIS PC E06/MF A01 - GPO		TI86000936	MN -15	11:239
1386	NTIS, PC A04/MF A01 - GPO		TI85015941	MN -78	11:705
1530-Pt.2	NTIS, PC A05/MF A01 - GPO		TI86000954	MN -41	11:579
1610-Vol.1-No.4	NTIS, PC A03/MF A01 - GPO		TI86000913	MN -15	11:240
1610-Vol.2-No.1	NTIS, PC A02/MF A01 - GPO		TI86000946	MN -15	11:241
1610-Vol.2-No.2	NTIS, PC A02/MF A01 - GPO		TI86000928	MN -15	11:242
1731	NTIS, PC A04/MF A01 - GPO		TI86000149	MN -15	11:243
1744-Vol.1	NTIS, PC A15/MF A01 - GPO		TI86000923	MN -15	11:244
1774-Vol.2	NTIS, PC A06/MF A01 - GPO		TI86000919	MN -15	11:245
1863	NTIS, PC A06/MF A01 - GPO		TI86000903	MN -70	11:191

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1864-Vol.2	NTIS, PC A08/MF A01 - GPO	TI85015953	MN -78	11:706
1890	NTIS, PC A19/MF A01 - GPO	TI86000961	MN -80	11:569
1910	NTIS, PC A05/MF A01 - GPO	TI86000921	MN -41	11:1431
1911	NTIS, PC A04/MF A01 - GPO	TI86000912	MN -32	11:1494
1916	NTIS, PC A05/MF A01 - GPO	TI86000911	MN -41	11:1470
1924	NTIS, PC A05/MF A01 - GPO	TI86000902	MN -80	11:707
1937	NTIS, PC A04/MF A01 - GPO	TI86000886	MN -80	11:708
1969	NTIS, PC A07/MF A01 - GPO	TI86000893	MN -80	11:546
1979	NTIS, PC A12/MF A01 - GPO	TI86000891	MN -80	11:709
2000-Vol.1-No.4	NTIS, PC A06/MF A01 - GPO	TI86000971	MN -80	11:710
2000-Vol.1-No.7	NTIS, PC A07/MF A01 - GPO	TI86000917	MN -80	11:711
2015-Vol.5	NTIS, PC A05/MF A01 - GPO	TI86000955	MN -80	11:712
2039	NTIS, PC A08/MF A01 - GPO	TI86000972	MN -80	11:713
2041-Vol.1	NTIS, PC A04/MF A01 - GPO	TI86000916	MN -15	11:246
2045	NTIS, PC A03/MF A01 - GPO	TI86000906	MN -79	11:1203
2061	NTIS, PC A02/MF A01 - GPO	TI86000892	MN -79	11:714
2068	NTIS PC E04/MF A01 - GPO	TI86000932	MN -41	11:1432
2087	NTIS, PC A07/MF A01 - GPO	TI86000900	MN -80	11:715
2095	NTIS, PC A04/MF A01 - GPO	TI86000956	MN -11	11:1486
2103	NTIS, PC A05/MF A01 - GPO	TI86000915	MN -11	11:1487
2104	NTIS, PC A03/MF A01 - GPO	TI86000914	MN -80	11:716
2108	NTIS, PC A02/MF A01 - GPO	TI86000908	MN -77	11:717
2116	NTIS, PC A02/MF A01 - GPO	TI86000942	MN -77	11:718
2122	NTIS, PC A04/MF A01 - GPO	TI86000883	MN -46	11:1166
2123	NTIS, PC A04/MF A01 - GPO	TI86000950	MN -70	11:192
2124	NTIS, PC A03/MF A01 - GPO	TI86000949	MN -70B	11:210
2161	NTIS, PC A05/MF A01 - GPO	TI86000938	MN -80	11:719
2181-Vol.1	NTIS, PC A03/MF A01 - GPO	TI86000890	MN -79p	11:720
2192-Vol.1	NTIS, PC A03/MF A01 - GPO	TI86000943	MN -70B	11:211
2193-Vol.1-Nos.3-4	NTIS, PC A05/MF A01 - GPO	TI86000963	MN -70	11:206
2215	NTIS, PC A02/MF A01 - GPO	TI86000884	MN -79p	11:580
2216	NTIS, PC A04/MF A01 - GPO	TI86000974	MN -85	11:157
2217	NTIS, PC A04/MF A01 - GPO	TI86000976	MN -15	11:247
2221-Vol.1	NTIS, PC A02/MF A01 - GPO	TI86000882	MN -77	11:721
2221-Vol.2	NTIS, PC A02/MF A01 - GPO	TI86000933	MN -77	11:722
2286	NTIS, PC A04/MF A01 - GPO	TI86000966	MN -70	11:212
2288	NTIS, PC A08/MF A01 - GPO	TI86000907	MN -15	11:248
2299-Vol.1	NTIS, PC A03/MF A01 - GPO	TI86000937	MN -79	11:723
2299-Vol.2	NTIS, PC A03/MF A01 - GPO	TI86000918	MN -79p	11:724
2317-Vol.1-No.4	NTIS, PC A03/MF A01 - GPO	TI86000970	MN -70	11:906
2331-Vol.1-No.1-2	NTIS, PC A07/MF A01 - GPO	TI86000975	MN -80	11:751
2353-Vol.1	NTIS, PC A09/MF A01; 1 - GPO	TI86000934	MN -80	11:539
2467	NTIS, PC A04/MF A01 - GPO	TI86000931	MN -80	11:907
2516-Vol.1-No.4	NTIS, PC A03/MF A01 - GPO	TI86000964	MN -70	11:1002
2542	NTIS, PC A06/MF A01 - GPO	TI86000968	MN -79	11:725
2543	NTIS, PC A06/MF A01 - GPO	TI86000969	MN -79p	11:726
2616	NTIS, PC A05/MF A01 - GPO	TI86000962	MN -70	11:213
2617	NTIS, PC A09/MF A01 - GPO	TI86000977	MN -70	11:214
3633-Vol.4	NTIS PC E04/MF A01 - GPO	TI86000039	MN -78	11:727
3816-4-Vol.32	NTIS, PC A11/MF A01 - GPO	TI86000725	MN -80	11:728
4043	NTIS, PC A04/MF A01 - GPO	TI85018314	MN -78	11:729
4108	NTIS, PC A04/MF A01 - GPO	TI86001824	MN -80	11:249
4141	NTIS, PC A04/MF A01 - GPO	TI86001823	MN -78	11:570
4156	NTIS, PC A07/MF A01 - GPO	TI86001324	MN -80	11:730
4166	NTIS, PC A99/MF A01 - GPO	TI86002085	MN -78	11:731
4253	NTIS, PC A06/MF A01 - GPO	TI86001106	MN -78	11:732
4256	NTIS, PC A06/MF A01 - GPO (GPO Dep.)	E 1.99: TI86001474	MN -78	11:733
4257	NTIS, PC A05/MF A01 - GPO	TI85016827	MN -80	11:734
4272	NTIS, PC A04/MF A01 - GPO	TI86001565	MN -80	11:505
4278	NTIS, PC A15/MF A01 - GPO (GPO Dep.)	E 1.99: TI86001251	MN -78	11:735
4305	NTIS, PC A04/MF A01 - GPO	TI85017406	MN -80	11:736
4321	NTIS, PC A03/MF A01 - GPO	TI85017973	MN -83	11:224
4325	NTIS, PC A03/MF A01 - GPO	TI85016976	MN -78	11:737
4342	NTIS, PC A04/MF A01 - GPO	TI86002067	MN -80	11:738
4345	NTIS, PC A07/MF A01 - GPO	TI86001854	MN -78	11:158
4350/ 2	NTIS, PC A13/MF A01 - GPO	TI86000096	MN -80	11:739
4350/ 4	NTIS, PC A07/MF A01 - GPO	TI86001857	MN -78	11:740
4361	NTIS, PC A06/MF A01 - GPO	TI86002178	MN -80	11:494
4368	NTIS, PC A03/MF A01 - GPO	TI86000230	MN -78	11:741
4376	NTIS, PC A10/MF A01 - GPO	TI86900109	MN -78	11:742
4379-Vol.1	NTIS, PC A06/MF A01 - GPO	TI86900105	MN -70	11:908
4382	NTIS, PC A04/MF A01 - GPO	TI86900088	MN -41	11:1449
4383-Rev.7	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86001363	MN -78	11:743
NUREG/TR-				
0016	NTIS, PC A05/MF A01 - GPO	TI85901903	MN -78	11:752
NV-				
81-001	*See* DOE/SF/11624-T1	E 1.99: DE86000401	MN -66	11:433
OA-Trans-				
2736	NTIS (US Sales Only), PC A02/MF A01; 1	DE85902069	MN -95d	11:821
2757	NTIS (US Sales Only), PC A02/MF A01; 1	DE85902132	MN -98F	11:784
OAEP-				
1-109	NTIS (US Sales Only), PC A02/MF A01	DE86780031	MN -23	11:1433
1-111	NTIS (US Sales Only), PC A03/MF A01	DE86780017	MN -4	11:1031

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OEFZS-					
4312	NTIS (US Sales Only), PC A03/MF A01		DE85702765	MN -46	11:1784
OEVS-Mitteilung-					
2/ 85	NTIS (US Sales Only), PC A04/MF A01		DE86780090	MN -41	11:1324
OR-					
81-004	*See* DOE/R0/01318-T1	E 1.99:	DE86000487	MN -59	11:404
ORAU-					
246	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86002638	MN -13	11:1930
ORNL-					
5815	*See* NUREG/CR-1910		TI86000921	MN -41	11:1431
6110	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001486	MN -41	11:1351
6111	NTIS, PC A21/MF A01 (GPO Dep.)	E 1.99:	DE86001414	STD -20	11:1893
6200	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001369	MN -90d	11:2
6206	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002564	MN -90h	11:909
ORNL/CSD-					
128	NTIS PC E06/MF A01 (GPO Dep.)	E 1.99:	DE86001228	STD -15	11:250
ORNL/FMP-					
85/ 3	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001368	MN -90	11:16
ORNL/M-					
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001487	MN -25	11:910
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001488	MN -25	11:911
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001490	MN -25	11:912
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001491	MN -25	11:913
7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001493	MN -25	11:914
8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001494	MN -25	11:915
10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001496	MN -25	11:916
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001497	MN -25	11:917
12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001498	MN -25	11:918
13	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001499	MN -25	11:919
14	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001500	MN -25	11:920
15	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001501	MN -25	11:921
17	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001503	MN -25	11:922
18	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001504	MN -25	11:923
19	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001505	MN -25	11:924
20	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001506	MN -25	11:925
21	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001507	MN -25	11:926
23	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001806	MN -25	11:927
24	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001510	MN -25	11:928
25	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001511	MN -25	11:929
26	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001512	MN -25	11:930
27	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001513	MN -25	11:931
28	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001514	MN -25	11:932
29	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001515	MN -25	11:933
30	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001516	MN -25	11:934
32	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001518	MN -25	11:935
33	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001519	MN -25	11:936
35	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001521	MN -25	11:937
36	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001522	MN -25	11:938
37	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001523	MN -25	11:939
38	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001524	MN -25	11:940
39	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001525	MN -25	11:941
40	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001526	MN -25	11:942
41	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001527	MN -25	11:943
42	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001528	MN -25	11:944
43	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001529	MN -25	11:945
44	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001530	MN -25	11:946
45	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001531	MN -25	11:947
46	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001532	MN -25	11:948
47	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001533	MN -25	11:949
48	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001534	MN -25	11:950
49	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001535	MN -25	11:951
50	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001536	MN -25	11:952
51	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001537	MN -25	11:953
88	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001639	STD -48	11:1359
98	NTIS, PC A05/MF A01		TI86001300	MN -78	11:744
99	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001299	MN -22	11:1894
ORNL/NSIC-					
200-Vol.1-No.4	*See* NUREG/CR-2000-Vol.1-No.4		TI86000971	MN -80	11:710
200-Vol.1-No.7	*See* NUREG/CR-2000-Vol.1-No.7		TI86000917	MN -80	11:711
ORNL/NUREG-					
80/ P2	*See* NUREG/CR-1530-Pt.2		TI86000954	MN -41	11:579
ORNL/NUREG/CSD/TM-					
13	*See* NUREG/CR-2122		TI86000883	MN -46	11:1166
ORNL/NUREG/TM-					
190/ Vol.3	*See* NUREG/CR-0150-Vol.3		TI86000924	MN -41	11:1313
346	*See* NUREG/CR-1386		TI85015941	MN -78	11:705
364	*See* NUREG/CR-1122		TI86000150	MN -79p	11:704
450	*See* NUREG/CR-2045		TI86000906	MN -79	11:1203
454	*See* NUREG/CR-2068		TI86000932	MN -41	11:1432
456	*See* NUREG/CR-2123		TI86000950	MN -70	11:192
ORNL/Sub-					
79-42539/ 1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001470	MN -95d	11:1003
79-42539/ 2	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001471	MN -95d	11:1181
79-42539/ 4	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001473	MN -95	11:813

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80-61618/ 1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001463	STD -95d	11:1215
82-22252/ 3	*See* NUREG/CR-4305		TI85017406	MN -80	11:736
83-28915/ 2	*See* NUREG/CR-4257		TI85016827	MN -80	11:734
83-43374/ 1/ Vol.1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001430	STD -97	11:1276
83-43374/ 1/ Vol.4	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001431	STD -97a	11:1277
84/ 73986/ 1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86001443	STD -97a	11:1278
84-73986/ 2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001442	STD -97a	11:1279
ORNL/TM-					
1168/ R2-Pt.3	NTIS, PC A11/MF A01 (GPO Dep.)	E 1.99:	DE86001432	MN -80	11:745
7809	*See* NUREG/CR-2116		TI86000942	MN -77	11:718
7884	*See* NUREG/CR-2215		TI86000884	MN -79p	11:580
7889	*See* NUREG/CR-2221-Vol.1		TI86000882	MN -77	11:721
7946	*See* NUREG/CR-2299-Vol.1		TI86000937	MN -79	11:723
7974	*See* NUREG/CR-2299-Vol.2		TI86000918	MN -79p	11:724
7985-Pt.1	*See* NUREG/CR-2353-Vol.1		TI86000934	MN -80	11:539
8091	*See* NUREG/CR-2221-Vol.2		TI86000933	MN -77	11:722
9443	*See* NUREG/CR-4043		TI85018314	MN -78	11:729
9467	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001424	MN -70	11:215
9507	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86002556	STD -20f	11:1845
9512	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001465	STD -20	11:1895
9533	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001469	STD -20	11:1896
9535	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001467	MN -11	11:47
9539	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001445	MN -25	11:1004
9550	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001448	STD -20f	11:1897
9559	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001446	STD -79	11:474
9563	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE86001866	MN -71	11:159
9574	*See* NUREG/CR-4256	E 1.99:	TI86001474	MN -78	11:733
9576	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001371	MN -61A	11:313
9601	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001438	MN -78	11:479
9641	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001370	MN -34C	11:1785
9642	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001373	MN -34C	11:547
9682	*See* NUREG/CR-4325		TI85016976	MN -78	11:737
9692	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001466	MN -41	11:772
9709	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001447	MN -80	11:589
9715	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001372	MN -70B	11:193
9735	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001376	MN -90	11:457
9754	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001450	MN -11	11:1336
9756	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001720	MN -70A	11:194
PB-					
84-903001	*See* DOE/TIC-8200-R48	E 1.99:	DE84010075	STD -80	11:543
85-186740/ XAB	NTIS, PC A03/MF A01				11:1401
85-208288/ XAB	NTIS, PC A02/MF A01				11:480
85-208320/ XAB	NTIS, PC A02/MF A01				11:106
85-209914/ XAB	NTIS, PC A02/MF A01				11:1396
85-210003/ XAB	NTIS, PC A02/MF A01				11:1474
85-210037/ XAB	NTIS, PC A02/MF A01				11:56
85-211266/ XAB	NTIS, PC A17/MF A01				11:773
85-212058/ XAB	NTIS, PC A07/MF A01				11:1292
85-212223/ XAB	NTIS, PC A04/MF A01				11:394
85-212959/ XAB	NTIS, PC A12/MF A01				11:1293
85-213429/ XAB	NTIS, PC A04/MF A01				11:57
85-214245/ XAB	NTIS, PC A04/MF A01				11:780
85-214534/ XAB	NTIS, PC A02/MF A01				11:1321
85-214567/ XAB	NTIS, PC A03/MF A01				11:843
85-214666/ XAB	NTIS, PC A03/MF A01				11:58
85-216976/ XAB	NTIS, PC A03/MF A01				11:1294
85-217669/ XAB	NTIS, PC A04/MF A01				11:88
85-218204/ XAB	NTIS, PC A04				11:1295
85-218808/ XAB	NTIS, PC A03/MF A01				11:1210
85-219947/ XAB	NTIS, PC A02/MF A01				11:1402
85-220697/ XAB	NTIS, PC A05/MF A01				11:1450
85-220721/ XAB	NTIS, PC A04/MF A01				11:83
85-220796/ XAB	NTIS, PC A03/MF A01				11:1296
85-220812/ XAB	NTIS, PC A03/MF A01				11:1403
85-220945/ XAB	NTIS, PC A02/MF A01				11:1404
85-220952/ XAB	NTIS, PC A02/MF A01				11:1405
85-221026/ XAB	NTIS, PC A10/MF A01				11:84
85-221380/ XAB	NTIS, PC A03/MF A01				11:216
85-221547/ XAB	NTIS, PC A05/MF A01				11:1297
85-222420/ XAB	NTIS, PC A03/MF A01				11:67
85-222792/ XAB	NTIS, PC A02/MF A01				11:1337
85-222834/ XAB	NTIS, PC A04/MF A01				11:1338
85-222875/ XAB	NTIS, PC A03/MF A01				11:1406
85-223030/ XAB	NTIS, PC A03/MF A01				11:475
85-223394/ XAB	NTIS, PC A04/MF A01				11:814
85-223915/ XAB	NTIS, PC A04/MF A01				11:815
85-224640/ XAB	NTIS, PC A12/MF A01				11:59
85-225688	NTIS				11:105
85-226322/ XAB	NTIS, PC A03/MF A01				11:1339
85-227502/ XAB	NTIS, PC A02/MF A01				11:495
85-227759/ XAB	NTIS, PC A04/MF A01				11:1298
85-228864/ XAB	NTIS, PC A08/MF A01				11:60
85-233393/ XAB	NTIS, PC A09/MF A01				11:1299
231535	NTIS				11:1300

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PFC/CP-					
85-6	*See* DOE/ET/51013-T157	E 1.99:	DE86001109	MN -20	11:1816
PFC/JA-					
85-8	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001609	MN -20	11:1898
85-27	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001315	MN -20b	11:1846
85-29	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001544	MN -20	11:1847
PFC/RR-					
85-6	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001848	MN -20d	11:1899
85-12	*See* DOE/ET/51013-155	E 1.99:	DE86001110	MN -20b	11:1881
85-19	*See* DOE/ET/51013-159	E 1.99:	DE86002001	MN -20	11:1882
PNL-					
5017	*See* NUREG/CR-4361		TI86002178	MN -80	11:494
5154	*See* NUREG/CR-4108		TI86001824	MN -80	11:249
5306	*See* SAND-84-7212	E 1.99:	DE86002091	MN -70	11:1476
5496-Rev.1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001437	MN -95d	11:816
5536	NTIS, PC A16/MF A01 (GPO Dep.)	E 1.99:	DE86000574	MN -95	11:867
5563	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001436	MN -95	11:1211
5566	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001224	MN -60	11:438
5569	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001944	MN -85	11:160
5578	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001435	MN -70	11:195
5591	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001117	MN -71	11:1167
5607	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001682	MN -95d	11:817
PNL-SA-					
12855	NTIS, PC A02/MF A01 - GPO		TI86001641	MN -80	11:746
13040	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001645	MN -95d	11:818
13101	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001673	MN -80	11:571
13225	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017928	MN -41	11:1258
13253	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001674	MN -4	11:1032
13306	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018527	MN -4	11:1067
13357	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017930	MN -46	11:1168
13375	NTIS, PC A02/MF A01 - GPO		TI85018523	MN -70B	11:217
13392	NTIS, PC A02/MF A01		DE85018525	MN -83	11:167
PNL-TR-					
453	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001606	MN -85	11:162
PPPL-					
2100	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002527	STD -20g	11:1848
2249	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002539	STD -20d	11:1900
2260	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002533	STD -20	11:1849
2274	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002532	STD -20f	11:1171
PTB-FMBR-					
104	NTIS (US Sales Only), PC A02/MF A01		DE85752707	MN -25	11:954
PWA-					
16/ 85	*See* KFK-3935		DE85752714	MN -15	11:231
RAL-					
84-129	NTIS (US Sales Only), PC A04/MF A01		DE85702743	MN -34B	11:1507
RAND/WN-					
10421-DOE	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001875	MN -21	11:1901
RFP-					
3827	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000880	STD -4	11:145
3837	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001552	MN -70	11:196
3877	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001553	MN -25	11:955
RHO-C-					
20	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001594	MN -70B	11:1475
RHO-PB-SR-					
10-B-CP	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001940	MN -22	11:149
10-B-CP-1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001942	MN -22	11:150
10-B-WM-JUL.85	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001136	MN -70	11:197
RI-					
81-005	*See* DOE/R1/25251-T1	E 1.99:	DE86000365	MN -64	11:436
RR-					
151	*See* PB-85-214666/XAB				11:58
RS-					
247/ 85	*See* OEFZS-4312		DE85702765	MN -46	11:1784
SAN-					
0499-29-3-80	*See* DOE/SF/10499-T74	E 1.99:	DE86000661	MN -62a	11:359
0499-31-Rev.1	*See* DOE/SF/10499-T75S	E 1.99:	DE86000688	MN -62a	11:360
0499-43	*See* DOE/SF/10499-T87S	E 1.99:	DE86000653	MN -62a	11:361
0499-82-Bk.1-Sect.1	*See* DOE/SF/10499-T141		TI86000698	ND -62a	11:366
0499-82-Bk.1-Sect.6	*See* DOE/SF/10499-T152	E 1.99:	DE86000681	MN -62a	11:368
0499-82-Bk.2-Sect.4	*See* DOE/SF/10499-T148	E 1.99:	DE86000720	MN -62a	11:367
0499-82-Sect.8	*See* DOE/SF/10499-T155	E 1.99:	DE86000656	MN -62a	11:369
0499-86	*See* DOE/SF/10499-T164	E 1.99:	DE86001394	MN -62a	11:371
0499-86-Vol.3-Sect.	*See* DOE/SF/10499-T163	E 1.99:	DE86001393	MN -62a	11:370
0499-86-Vol.4-Sect.3	*See* DOE/SF/10499-T166	E 1.99:	DE86001396	MN -62a	11:372
SAND-					
79-0369	*See* NUREG/CR-0743		TI86000909	MN -11	11:1356
79-2071	*See* NUREG/CR-1117		TI86000898	MN -71	11:156
79-2079	*See* NUREG/CR-1151		TI86000167	MN -41	11:1314
83-0451	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002094	MN -70	11:198
83-1884	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001144	MN -70	11:199
83-2618	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001681	MN -15	11:251
84-1072-4-Vol.32	*See* NUREG/CR-3816-4-Vol.32		TI86000725	MN -80	11:728
84-1076	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001779	MN -70	11:200
84-1188C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85012348	MN -25	11:1005

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84-1307	*See* NUREG/CR-4342		TI86002067	MN -80	11:738
84-7122	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002102	STD -71	11:161
84-7212	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE86002091	MN -70	11:1476
85-0012-Rev.7	*See* NUREG/CR-4383-Rev.7	E 1.99:	DE86001363	MN -78	11:743
85-0195	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86001611	MN -25	11:1204
85-0225C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010671	MN -38	11:1172
85-0486	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002095	MN -25	11:1192
85-0738	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001148	MN -4	11:1033
85-1138	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001153	STD -66c	11:431
85-1379C	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86000434	MN -38	11:1153
85-1484C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85014463	MN -38	11:1205
85-1495/ 2	*See* NUREG/CR-4350/2		TI86000096	MN -80	11:739
85-1495/ 4	*See* NUREG/CR-4350/4		TI86001857	MN -78	11:740
85-1523C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000863	MN -25	11:956
85-1686	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001689	MN -45	11:1270
85-1688	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86002093	MN -25	11:957
85-1776	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002096	MN -70	11:201
85-1936C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001320	MN -41	11:1259
85-2009	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86001680	MN -38	11:1193
85-2040C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000433	MN -38	11:1154
85-2126C	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86001265	MN -21	11:1850
85-2131C	NTIS, PC A02/MF A01 - GPO		TI86000426	MN -80	11:747
85-2154C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001622	MN -28	11:1221
85-2185C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000432	MN -41	11:1435
85-7157	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001746	STD -70	11:225
85-7206	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001690	MN -70	11:202
85-7238	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001937	MN -90d	11:17
SANSP-					
90	NTIS (US Sales Only), PC A06/MF A01		DE86780103	MN -11	11:1340
SCPRI-RM-					
2-1985	NTIS (US Sales Only), PC A03/MF A01		DE85752882	MN -11	11:1316
SERI/SP-					
271-2728	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008811	STD -63	11:338
SERI/STR-					
211-2755	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85016856	STD -63	11:315
211-2756	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85016858	STD -63	11:316
SERI/TR-					
255-2410	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE85012138	MN -63	11:414
SERP-E-					
107	*See* IFVE-ONF-84-155		DE85702761	MN -34D	11:1577
SFR-					
101	Fluor Corporation				11:18
SLAC-PUB-					
3571	*See* DESY-85-018		DE85752131	MN -34D	11:1570
SLU-IST-					
36	*See* STEV-EO-85-3		DE85752738	MN -61A	11:317
SMHI-MK-					
1984-3	*See* STEV-VIND-84-15		DE85752723	MN -60	11:439
SRD-R-					
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E Engineering materials
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TG Translation (general)
TA Translation (analytic)

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UY Uruguay

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Atmospheric Science and Power Production is the third publication in a series of scientific publications sponsored by the U. S. Atomic Energy Commission and its predecessor agencies, the U. S. Energy Research and Development Administration and the U. S. Department of Energy. The first book, *Meteorology and Atomic Energy,* was published in 1955; the second, *Meteorology and Atomic Energy—1968,* in 1968. The present edition is designed to update and to expand on many of the important concepts presented previously, but it draws heavily on recent contributions made by atmospheric science to the analysis of air quality and on results originating from research conducted and completed in the 1970s. Special emphasis is placed on the contribution of atmospheric science to solving problems related to the fate of combustion products released into the atmosphere.

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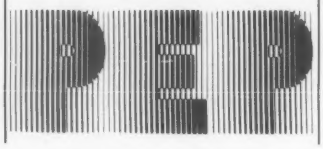

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